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ARTICLE I.

Experiments and Observations on the Adhesion of the Particles of Water to each other. By BENJAMIN, *Count of Rumford, F. R. S. &c. Communicated by the Author to the National Institution of France, and transmitted to him by the Editor.*

(Concluded from page 159.)

TO prove this fact in another manner, I again varied the experiment, by placing a stratum of ether immediately upon the mercury. The particles of this liquid appear to have very little adhesion to each other; for which reason I imagined that the kind of film that would be formed at its surface, must have very little force. The results of my experiment fully confirmed this conjecture.

A stratum of ether upon mercury—

The very smallest spherules of mercury which I let fall through this liquid, seldom failed to mix immediately with the mass of mercury on arriving at its surface, where they entirely disappeared; and I have never succeeded in causing either a spherule of mercury, or the smallest metallic particle, nor any other body of greater specific gravity than ether, to swim upon its surface.

— appears to afford no resistance to descending bodies.

Alcohol.

The results of the experiment were not perceptibly different when alcohol was substituted in the place of ether.

The evaporation of ether—

It is known that ether evaporates very rapidly. Is not this another proof that the particles of this liquid adhere to each other with much less force than those of water? But the following experiment proves this fact in a decisive manner.

EXPERIMENT VII.

is incomparably greater than of water, and shews less adhesion.

Having half filled a small cylindrical glass with mercury, I placed on the mercury a stratum of ether four lines in thickness, and blew upon the ether with a pair of common bellows.

In less than one minute the ether had disappeared.

The same experiment being made with water, no sensible quantity of this fluid had disappeared in one minute.

Dust, which has no adhesion, rises by the wind;

The objects which are before our eyes from the earliest periods of our lives seldom employ our meditation, and not often our attention. We see, without surprise, immense masses of dust raised by the winds and carried to great distances; and at the same time we know that every particle of this powder is really a stone, almost three times as heavy as water, and of a size so considerable, that its form may be perfectly seen by means of a good microscope.

And we see also, without surprise, that water, which is much lighter than dust, and is composed of particles incomparably smaller, is not carried off by the winds in the same manner.

—but those of water do not.

In order to convince ourselves that the particles of water do strongly adhere to each other, and that they require to be so in order to prevent the greatest confusion in the universe, we need only figure to ourselves the inevitable consequences that would result from the want of such an adhesion.

If they did not adhere, they would rise more easily than dust.

The particles of water would be raised and carried off by the winds with infinitely more facility than the finest and lightest dust. Every strong breeze setting in from the Ocean would bring with it a great inundation. Navigation would be impossible, and the banks of all the seas, lakes, and large rivers would be uninhabitable.

The adhesion of the particles of water to each other is the cause of the preservation of that liquid in masses. It covers the surface with a very strong pellicle, which defends and prevents it from being dispersed by the winds. Without this adhesion, water would be more volatile than ether, and more fugitive than dust.

But the adhesion is also the cause of other phenomena, which are of the greatest importance in the phenomena of nature.

The viscidity which results from the mutual adhesion of the particles of water renders this fluid proper to hold all kinds of bodies in solution; as well the most heavy as the lightest; provided always that they be reduced to very minute particles. Hence all bodies may be suspended in water.

I have found by a calculation, founded on facts which appear to me to be decisive, that a solid spherule of pure gold, of the diameter of one 300,000th of an inch, would be suspended in water by the effect of its viscidity; even though this small body should be completely wetted and submerged in a tranquil mass of the fluid *. Calculation of their size.

This viscidity, or want of perfect fluidity, which causes it to hold every kind of substance in solution, renders it eminently proper to become the vehicle of nourishment to plants and animals; and we accordingly see, that it is exclusively employed in this office. The nutriment of plants and animals is thus conveyed.

If the adhesion of the particles of water to each other were to cease, and the fluidity of this body were to become perfect, every living being would perish by inanition.

May I be permitted to remark the simplicity of the means employed by Nature in all her operations—May I be permitted to express my profound admiration and adoration of the Author of so many wonders!

* Fragments of gold leaf, which are about one-280,000th of an inch thick, subside in water with considerable velocity. This, however, does not invalidate the argument in the text. N.

II.

Abridged Extracts relating to the means used to reduce the weight of Horse Jockies and the methods of Training Horses, so as to augment their Strength, Wind, and Speed. From Sir John Sinclair's *Pamphlet on Athletic Exercises.*

SIR Charles Bunbury transmitted a letter from W. S. Rickword, Esq. who after mentioning some of the difficulties of collecting information from many of the persons of the class who practise the arts in question, proceeds to give the following observations, p. 65.

Physic is not much used in training men or horses.

"Physic of no kind is used now, so common as it used to be, either in wasting men to ride, or in training them to pugilistic engagements, or extraordinary muscular exertions of any kind. The number of questions put by this author might be compressed into a very few; like summoning and capitulating commanders of armed men, many of the articles are said to be answered in the foregoing, number so and so, as the numerous questions* (made use of in this pamphlet) are (in a great degree) by the following general observations. The good effects of air, exercise, and aliment, to animal bodies, to the attainment of health, is tolerably well known. No general rule can be laid down as to the mode of feeding; the quantity of exercise, or the time required, to bring either man or horse to perform the utmost he is capable of doing: the conformation, and idiosyncrasy of the body of each animal, the trainer should make himself acquainted with; men and horses differ in constitutions, as in dispositions. The great art amongst trainers is, *or should be*, to discover what quantity of exercise, &c. a horse will take to bring him to, and keep him at his best. As to physic, it is my opinion, that it is much too generally in use amongst racing horses in particular; but, upon that subject, I have more to say than is convenient for me to advance at present. More depends, far more, on exercise than is generally believed, even at this period, though the benefit is pretty well known and admitted; yet, by no means

Feeding not subject to any general rule.

Exercise, air and thorough grooming required by horses.

* See our Journal.

sufficiently;

sufficiently; pure air, proper exercise, good oats and hay, with thorough grooming, would bring horses to the starting post, far better able and in condition for running than they usually are brought, in consequence of the *too common* use of physic, and the quantity given at each dose. I am persuaded that alterative medicine would answer a better purpose than stronger physic, in most cases, where, even it is exhibited judiciously; I do not say, that physic is at no time proper, there are situations, when it is highly necessary; but I contend against the frequency of its exhibition, and the quantity exhibited; I do so, thoroughly convinced of its laying the foundation of some diseases, and rendering the animal incapable of contending against any other, with which he might unfortunately be attacked. As to the food used in the training of men, I should consider that which affords the most nutriment, occupying the least space, and digesting easy, to be the most proper, and likely to give the greatest assistance to the other requisites, in training them to perform any feats requiring extraordinary exertion of the muscular system; this attended to, with the benefit of free respiration (without which, nothing great can be performed, either by man, horse, or other animal) will admit of astonishing and wonderful powers and strength, either in wrestling, pugilism, walking, running, &c. &c.

Food for training men.

"As far as relates to strength and wind, the foregoing observations apply to fowl, as well as other animals. Fighting of all kinds I am an enemy to; cocking I never see, nor do I like to hear of it. The foregoing observations are hastily written, but rest on the best foundation."

Fowls.

Mr. Sandevir, an eminent surgeon at Newmarket, returned in substance, the following information to Sir John Sinclair.

The training of jockies of high repute is continued or kept up, more or less, from about three weeks before Easter to the end of October, which is about eight months: but a week or ten days are quite sufficient for a rider to reduce himself from his natural weight to a stone and a half below it. They breakfast very sparingly on bread and butter, with tea; dinner, fish, or else pudding with very

Particular account of the training by which jockies are reduced in weight, &c. It consists in taking little food and sharp exercise.

very little meat; wine diluted with twice its measure of water is their drink: tea in the afternoon with little or no bread and butter, and no supper. It appears that abstinence is their principal object.

As to their exercise, they load themselves with clothes, that is, five or six waistcoats, two coats, and as many pair of breeches; in which dress they take a severe walk of fifteen or sixteen miles after breakfast. On their return, they change their clothes for dry, and some who are much fatigued, will lay down for an hour before dinner. No severe exercise is taken after dinner; but the day is passed as they please. They generally go to bed at eight or nine, and rise about six or seven.

Those who are unwilling to take excessive exercise, have recourse to purgative medicine; which usually consists of two ounces of Glauber's salts.

This treatment recommended against corpulency.

Mr. Sandevir is positive in recommending a similar process for reducing corpulency in either sex, as from experience he perceives that the constitution does not appear to be injured by it: but he is apprehensive that very few indeed could be prevailed upon to submit to such severe discipline, unless he had been early inured to it.

Extreme case of sudden reduction.

This gentleman mentions as an additional fact, that John Arnall, when rider to the Prince of Wales, being desired to reduce himself as much as he possibly could, for a particular purpose, abstained from animal and even from farinaceous food for eight succeeding days, and eat only a piece of apple now and then. He was not injured by it at the time, and is now in good health. The writer also adds that Dennis Fitzpatric, a person at this time continually employed as a rider, declares that he is less fatigued by riding, and has more strength to contend with a determined horse in a severe race, when moderately reduced, than when allowed to live as he pleased, though he never weighs more than nine stone, and frequently has reduced himself to seven stone seven pounds.

Another person answered the queries to the following effect.

Another account of jockies, &c.

Jockies are trained and reduced by abstinence and by sweating, in consequence of additional cloathing and long

continued

continued walking. Neither their health nor their strength are impaired unless these practices are carried to excess. When much reduced they are peevish and irritable, but perhaps not less courageous than usual. Many of them are naturally lean, but some recover their weight very rapidly when the course of training is left off. Neither their health, nor their continuance of life appear to be affected by this practice.

Mr. Robson, an eminent trainer at Newmarket, gave in substance the following information respecting race horses.

Method of training race horses for the course.

The running horse is of a superior race.

Exercise, cleanliness and good provender constitute the treatment.

The perfection of a race horse consists in his wind, which is innate in their breed, and degenerates when mixed or crossed with other horses. It is observed sometimes that the other species of horses go nearly or quite as fast as the slower kind of race horse, but they very soon tire for want of wind, whilst the running horse has the peculiar merit, from his wind, of bearing fatigue so much better than any other breed of horses. The perfection depends on their parentage and on the female most. The foal must have corn during its rearing, otherwise it will not grow in proportion, but grow lean in the haunches. Different individuals of the same family will greatly differ in their natural constitution. Good size, with strength and symmetry of form, are essential to the running horse; but the most essential qualities are activity in speed, and good wind. With regard to form, he should be broad, deep, and have great declivity in his shoulders, his thighs let down very low, the hocks stand far behind and from him, thence downwards to the next joint, short, &c. large bones are preferred. Each sex is alike for speed, but the horse bears fatigue better. The foal is kept in grass fields in the state of nature till broke, and well fed with corn, as he will eat it, and with hay where grass is scarce. The training is began at two years and a half. Soft meal is a cooling food, but laxative and injurious when horses are at hurrying work.

Physic, food, &c. for race horses.

Race horses are purged two or three times a year; each course, perhaps three doses preparatory to their getting their training exercise. Mild physic which has no tendency to weaken, is made use of. (I suppose this to mean

a moderate

a moderate dose). Oats are the most esteemed provender for horses; and of these they have three feeds daily, of as much as they can eat with appetite. Their drink is soft water at least twice a day, always cold, except during physic or illness. Their skins are kept perfectly clean when in the stable, by friction with the brush and curry-comb, which clean and brace the skin and muscles. It is necessary to health and strength that they should be sweated, and this is done by putting on a few extra clothes and cantering them five or six miles according to their age and other circumstances. They are exercised twice a day; a mile or so in a gallop before they take water; and afterwards a short or long canter, as circumstances and their constitution require. The training is completed by good keep and a proper proportion of work, which enables them to bear fatigue. This is kept up for two or three months only, and effects no more than a temporary change in the animal. Running horses certainly live as long as others; they are not sooner worn out by the treatment they undergo, but on the contrary they bear fatigue much better than other horses.

Mr. Holcroft's account of running horses and their treatment

Mr. Holcroft's observations in the same treatise, nearly coincide with those of Mr. Robson. This celebrated dramatic writer lived at Newmarket, in his youth, under John Watson, the groom, who was employed in the two-fold office of training the horses and riding them. John Watson died at a very advanced age. I quote Mr. Holcroft's words, page 77.

They are purged and exercised.

"When the racing season is over, these horses have most of them green meat for some time, and repose from their severe exercise; their high spirit and vices soon begin to shew themselves, much to the terror of timid boys. Having fed grossly for a time, they are regularly purged, I forget how often, but I believe every other day, for three doses; and that these purgations are repeated, at intervals, three times. They then gradually begin to increase their exercise, so that, early in the spring, they remain out of the stable about eight hours in four-and-twenty, and take what are called four brushing gallops, two in the morning's exercise and two in the afternoon's; a brushing gallop means a gallop of nearly a mile, begin-

ning

ning at a moderate rate, increasing, and ending full speed. They are stinted in their water; the horse that blows the hardest, the most; their hay and oats are of the best quality; the hay is long in the stalk, and the seed shaken out; the oats are thrashed in a sack, and winnowed, and every care is taken to keep the horses from chaff and impurity of every kind. After feeding, their heads are muzzled. They are not allowed above six hours in the night; for they are supped up at nine, and out again at three in the morning; but they have the intervening hours in the day, between their morning and evening exercise. When they become wet, from the accidents of weather, or other things, they are carefully rubbed till dry. Each horse has a boy for the performance of all these particulars; they are occasionally sweated, I forgot how often; that is, they are heavily clothed, galloped nearly full speed for four miles, relieved from their violent perspiration, first by wooden scrapers, then by rubbing them till they are perfectly dry, and after a little gentle exercise, are taken home.

Stinted in their water.

Method of sweating.

I have spoken to the best of my memory of things that happened at least six-and-forty years ago, and concerning which, when I quitted Newmarket, I never imagined I should be more questioned. The skins of the horses are kept perfectly and peculiarly clean; severe perspiration is thought absolutely necessary. I see no reason to suppose that their lives are shortened; some of them live to a great age. Eclipse, I think, died above thirty.

They are not short lived.

III.

Second Letter from R. B. *on the Developement of Intellect and Moral Conduct in an Infant, during the earliest part of her Existence; being concluded at the fourth Month of her Age.*

To Mr. Nicholson.

Sir,

I thank you for inserting my paper on the Progress of Intellect in an Infant, and have now the pleasure of send-

Continuation of a register of the progress of an infant from twelve days old.

ing you the remainder of my notes on the same individual. As I have made it a particular point to keep close to what was actually written at the time, instead of trusting to any thing my memory might now suggest, you will find some repetitions and perhaps defects of style, which that resolution has prevented me from amending. The dates continue to express the age of the child, whose progress from one day to another became less marked, in proportion as her stores of knowledge and acquirement became greater when compared with the improvement of any short interval of time.

15th day of her age. Knows her mother at a short distance

Fifteenth day of her age. The infant decidedly knows her mother when near her; but doubtfully if distant. She has long known her when in her arms. Her acuteness of observation and the use of her hands improve, though slowly. She grows very fat and is indolent, probably from the constitutional habits of her age and growth, and perhaps from the less lively impression of surrounding objects to which she is now accustomed. I think she still shows me a marked preference of intelligent attention. This morning her mother was talking to her, and upon her giving some striking signs of pleasure, her mother called to me "do look at her,"—the infant instantly turned her head from her mother to me, and appeared highly pleased at my coming to her. This could scarcely be casual: if it was not, she must have made considerable progress in the knowledge of the shortest and most frequent sentences used respecting her, of which "do look at her," is certainly one of the most frequent.

—and is aware of the use of language.

19th. Diverted by other children.

Nineteenth day. She is highly interested and diverted at her brothers and sisters, who are running about the room and occasionally take notice of her.

23d. Endeavours to articulate.

Twenty-third day. The infant is very desirous of articulating, and makes many efforts, by varying the form of the mouth and position of the tongue. When she succeeds in producing the resemblance of a word or syllable she is much pleased and shews her satisfaction by motions of the legs and arms. She never makes this effort but when engaged and attentive to some person who speaks to her, and whose approbation she seems to court by an endeavour at imitation.

Twenty-sixth day. She can without any difficulty utter many voluntary simple sounds at pleasure. Her wants being now more numerous and habitual, she betrays more impatience than formerly, at privations or inconveniences. This impatience appears to be grounded upon a moral deduction that she has a claim or right to be indulged. 26th day. More perfect in articulating;

It is to be observed that her health, appetite and sleep have hitherto been perfect, and she has become much fatter than at the earlier part of her life.

She was baptized three days ago, and of course does not yet know her own name; but she has long known the word "child," as denoting herself. —knows that the word child denotes herself

Sixth week elapsed. The infant very decidedly knows that the word "mama" denotes her mother, which word pleases her more than any other, except the word "child." She knows her own name and attends when called by it. Conversation fixes her notice, even though not addressed to herself; and she can utter many sounds without hesitation or effort, in the imitation of conversing or answering, very differently from her manner a few days ago. 6th week. Knows her own name and various other words.

Seventh week. Her preference, directed to her mother, myself, and other favourites, are now expressed in a variety of ways. She holds out her arms and leans beyond the equilibrium, in order to prevail on us to take her from her maid, at the same time that her looks and voice are perfectly intelligible and expressive. 7th week.

Ninth week elapsed. C—— is now more pleased to listen to distinct general conversation, than to common phrases addressed to herself. I suppose this preference to arise chiefly from the greater variety of tones and articulate sounds which are new to her, and perhaps from the interest she may take in the concomitant action of the speakers. Her general habits and use of the eyes have gradually improved in accuracy and minuteness. She has nearly, but not perfectly, a command of the vertical position of the head; and turns to the place whence a voice addressed to herself, proceeds. But she does not always perform this last action with certainty and precision. In the use of her hands she gradually improves; and particularly exerts this action in feeling or pinching the breast 9th week. Attends to general conversation. —can support the head and look round by acting with the muscles on the neck.

 while

Uses the hands but not in connection with the eyes.

while sucking. There is yet, however, very little connection between the hand and the eye. While she is at the breast, contemplating her mother's face, she occasionally stretches forth her arms and is delighted if her mother will lean forward and kiss her hand. Her smile, which originally seemed to denote simple pleasure, is now more expressive and intelligent. She laughs at being mocked or suddenly deprived of the breast; and waits with some eagerness for a repetition of the trick. The nurse's practice of covering the child's face with her pin-cloth, and then suddenly plucking it off affords her diversion. Keys rattled before her, or a nosegay held near her, are viewed with eager attention and prominence of the mouth; at the same time that she grasps her own clothes, but does not attempt to apply the hand to the object of attention. She has a very marked fondness for her mother, and shews it, occasionally, by applying her mouth, opened very wide, against her mother's cheek, making at the same time, a gentle noise expressive of affection.

Pleased with tricks and mockery.

Very attentive to objects held to her; but does not try to take them.

10th week. No attempt to seize visible objects.

Tenth week. Though her improvement in connecting the action of the hands with the sense of sight is very evident in her manner of taking hold of her own clothes or her mother's neck-handkerchief, yet she makes no attempt to seize any thing, in consequence of first seeing it.

Peculiarity in the infant face; noticed by Hogarth:

Hogarth in his "Analysis" of beauty mentions as one of the characters of the infant face, that the iris or coloured circle of the eye, being nearly of the same size in all ages, bears a greater proportion than usual to the size of the face in young subjects. But there is another more striking and very general difference. In this infant, the bony edge which supports the eye-brow, being naturally low, the upper eye-lid at first covered part of the iris as it does in many adults; but when the face became full and prominent, as is the case with thriving children, the lower eyelid, being pressed upwards, covered more of the iris, than the upper. This effect is common with infants, but is, I think, never seen at a more advanced age.

—another still more remarkable.

11th week. Attempts to speak or answer by sounds

Latter end of the eleventh week. The attachment of C—— to her mother seems to increase. She laments or whines when the servant carries her away. Her attempts to

to speak improve in manner and precision of answering when spoken to, which she does by a sound sometimes of pleasure and sometimes of mere assent or attention. These sounds considerably resemble those of a monkey we had some years ago, which was habituated to reply to kind language. Her mother, as well as myself, thinks C——'s power of mind and observation are at this time much superior to that of the monkey; but her education, or quantity of acquired habits, less.

—resembling the language of a monkey.

C—— refused to go from her mother to her eldest sister, but readily left her to come to me. She knows when her maid, though absent, is called to take her. The amusement of spinning a half crown on the table diverts her much, but she makes no attempt to seize it. If however it happens to touch her hand, she is greatly entertained, and seems to have a notion of possessing it.

Spinning a piece of money.

Twelfth week, or age nearly three months. The variety of tones and what may be called words which C—— can now command, are sufficient to make herself perfectly understood, as to pleasure or pain or the mental affections, without crying; and she certainly understands quite enough of language to apprehend all that her wants and powers require to be communicated. She does not yet attempt to seize any object, with her hand under direction of the eye.

12th week. Makes herself well understood.

End of thirteenth week. C—— having been ill with a complaint in the bowels, has shewn the most marked partiality for me; so as to quit the breast to come to me, when I appear. I think this arose from an habitual conviction that I, as the adviser and director of the family, could do her good*. It is probable also that my greater personal strength and ability to walk about with her and also the facility with which she and I understand each other, might afford strong motives of preference, by giving her that amusement which beguiles pain.

13th week. In illness she is attached to her father.

She has often and long ago been carried to a looking glass, which amuses her. From various facts I am convinced

She knows that a looking glass

* The same attachment and conviction has always been manifest in the illness of her and my other children at later periods.

shows images only.

vinced she at present knows that the figures are not real persons, but represent herself and others.

Three months old. First connection of the hand with the sight.

End of the fifteenth week, or age exactly three calendar months. Yesterday C——, who has been assiduously watched for that purpose, did not move her hand to take up any thing; and to day, at six in the evening, she completely acted with the hand and eye in conjunction. It seems as if this operation had been projected and previously arranged in her mind. She raises her arm by the shoulder-joint to a level with the object she desires to take, and then by an horizontal sweep, brings her hand before her, opening and shutting the hand till she has clasped the object, in which she does not readily succeed. Anxiety and impatience accompany this manoeuvre, and, on the whole, she is a good deal vexed with the desire to possess in this new way and the difficulty of bringing her hand to the object. I think she uses her right hand with rather more success than the other. When she had, with both hands at once, grasped the tea tongs, she could not command the voluntary power of letting go and therefore cried from the confinement of her hands.

The operation was curious and seems to have been studied or planned.

3½ months. Articulation, language, &c.

Three months and a half old. That effort at articulation which nurses call telling a long story, was very earnestly practised at this period, and some days afterwards she became very troublesome, from a wish to seize whatever was in her view. That habit of tossing the arm up and down, which infants acquire, and to which some authors ascribe the use of the right hand in preference to the left, was also exhibited at about four months old*. And soon afterwards her knowledge of words and things was so far advanced, that she knew her hands and feet by

She knows her

* The argument is that infants are usually carried on the right arm, because it is stronger; and in this position, the right arm of the child being at liberty, is said to be exercised more readily and early. It does not seem however, that there is much force in this remark; for the nurse is as likely to carry them on her left arm, in order to have the free use of her own right arm; and even on the former supposition, it seems to me that the arm nearest the nurse, would probably be more fully exercised by taking hold of her, or her clothes, than the other, which for the most part can have no object within its reach. B.

name;

name; that is to say, she shewed them when asked "which is your hand,"—"which is your foot," provided her attention was not turned to other objects.

hand and her foot by name.

To this period I carried my journal. The subsequent months were not noticed; and indeed in these she became one of the family as to general intercourse, making herself understood by all, and comprehending what was said to her to the full extent of her understanding and the simplicity of her wants. I shall not extend my communication by arguments and inferences; but will only take notice that children do not speak sentences, and indeed scarcely words before they are twelve or fourteen months old, though my narrative seems to shew that they possess ability to do it much earlier. On this subject I would remark that the latter part of the first year of the life of an infant, is a time of indolence; when most of their wants are supplied by attendants who are constantly with them; and in the lower ranks of society, they are so ignorantly treated that they do not speak intelligibly for years; and again that they seldom have their teeth till after the twelvemonth. I have known a child who had teeth at six months, and spoke many words very well at that period, with a knowledge of their meaning*; but though he was highly satisfied at his own performance, he did not find motives for proceeding in his labours after language, till about the fourteenth month, when he began to run about, and found his wants and views so multiplied under this new change of circumstances, as to require a greater share of diligence than he had found needful in the arms of his protectors.

The journal ends here.

Qu. Why do not children speak earlier than at twelve months?

Because their necessity for speech does not operate till they walk, &c.

—and they have not teeth.

Instance of a child who had teeth and spoke at six months; but did not persevere, nor was he more advanced at the twelvemonth than other children.

I remain,

Sir,

Your constant reader,

R. B.

* He is now a very intelligent, unaffected boy; but has no extraordinary claims to notice, either in his own opinion or that of others. B.

IV.

On the Culture of Beans preparatory to a Wheat Crop. By John Christian Curwen, *Esq. M.P. of Workington Hall, Cumberland*.*

Sir,

Cultivation of beans and wheat, &c.

THE offer of a premium by the Society of Arts, &c. for the culture of beans preparatory to a wheat crop, being, as I conceive, for the purpose of demonstrating the superiority of green crops over dead fallows; I shall be considered, I flatter myself, as acting consonant to the views of the Society, in offering a detailed account of my proceedings, more especially as it will appear incontestably, that, if any advantage has resulted from a trial under such very unfavourable circumstances, the most sanguine expectations may fairly be entertained of the general utility of the system.

The plot of ground on which the experiment has been made, contains forty-two acres, the soil is a stiff clay, so flat as to afford very little fall for the water. The least continuance of rain renders it unworkable, though it has been drained as far as was practicable. It was broken up in the spring of 1800, and in that and the following year was under oats, both crops very heavy; in 1802 it was set with potatoes; in June, they were run through with the potatoe harrow, and made quite flat before they could be stitched up again. The wet set in and continued so long, that the crop was in a great measure ruined, and the weeds got to such a head that it was not possible to get the ground cleaned. It was sown with wheat in November 1802, by great exertions, but it was in so very unfit a situation that the greatest part of the seed perished: above half was re-sown with oats, in April 1803, being as soon as it could be got upon. Immediately after the crop was got off (early in October 1803) the stubble was turned up: in many parts the grass was

* This communication was made to the Society of Arts, in three letters to the Secretary, which I have here given without abridgement.

so

so thick and strong, as to make it difficult for the plough to get through it. The winter proved so mild that it had done it little good. In many parts the harrows could not break it, and the grass was obliged to be cut and carried off by the hand. The advantage of a second ploughing would have been great, but by attempting it I might have lost the season for getting in the beans; I was restrained therefore from attempting it.—Forty acres were drilled before the end of February 1804, with a drill of the construction of Mr. Mac Dougals, six feet wide, sowing the rows at twenty-six inches apart. The weeds and roughness of the land would not admit of the drills being kept exactly straight, which occasioned additional trouble in cleaning, as also some loss in the crop. Forty-nine and a half Winchester bushels were sown.—I have been thus particular, to convey a just idea of the uncommon foulness of the ground, and the difficulty I had to contend with in consequence of it. The beans came up extremely well, notwithstanding the extreme severity of the spring. No step was taken in cleaning till the 10th of May 1804; this neglect proceeded from the multiplicity of other business, and my over-man being unacquainted with the drill husbandry, and the advantages of beginning to destroy the weeds as early as possible; from the 10th of May till the middle of July, which was as long as it was practicable to continue, the ploughs and harrows were constantly employed, and it was twice hand-weeded during the time. The cutting of the beans commenced the 20th of August: had the weather permitted, it might have been a week earlier. The method followed, which I had practised with success the year before, was to cut and spread the beans thinly, and to leave them exposed to the sun two days previous to binding. By the 26th, the whole was cut, and the field cleaned by the 29th.—I gained by these means above a month, which on wet land is of infinite advantage; I had great mortification in finding, after cutting the beans, the stitches extremely foul, notwithstanding all the pains I had taken. Any thing so dirty as this ground could seldom be met with; the season was very favourable, and I began to clean it immediately; I gave it two ploughings,

Cultivation of beans and wheat, &c.

Cultivation of beans and wheat, &c.

and in some parts three, breaking it with harrows, raking and hand-picking it. I had, by the 20th of September 1804, the satisfaction of seeing it in a better situation than any fallow in the neighbourhood, and began to plough for wheat; on the 29th it was completely drilled, rolled, and water-furrowed. My friend Mr. Green, a member of the Society, who visited the field, was so struck with the busy scene, that he requested to have the people and the horses counted. There were fifty-nine men and women, and thirty-one horses; fourteen single, and one double cart, four ploughs, four harrows, drill, roller, and water-furrow plough, a horse each. It took sixty-two and a half Winchester bushels of seed; I had sixty carts of compost per acre, composed of dung, ashes, and street-rakings, that had been collected during the summer, and laid in the most convenient situations to facilitate the work. The filling, leading and spreading of 2500 carts of compost was a work of some magnitude; the month of October proved so wet, that, had it been delayed a week later, I should not have been able to have accomplished it. The labour it cost me after the beans were cut was very little inferior to a regular fallow; notwithstanding, the result, with this increased expense, will be found to be in favour of the experiment. The tick bean, which was sown on thirty-nine acres out of the forty, produced more abundantly than the other bean, which was sent me by Messrs. North and Bridge, and, being a later bean, is not adapted to this climate. The crop was good; one stalk of the tick bean had 70 pods, and these produced 353 beans; the weight, four stone thirteen pounds the Winchester bushel; the other bean, four stone four pounds. The crop produced 2010 stooks; from a few stooks which were left out of the stacks for the purpose of affording specimens for the Society, I have reason to suppose they will yield ten quarts per stook, or 628 Winchester bushels. I estimate by the London seed, which is least productive. The selling price is five shillings per Winchester, which would make the amount £167 9*s*. 4*d*. The stooks had been exposed to the inspection of various persons who wished to see in what state the beans were, so that I suppose some loss in the quantity,

quantity. The following is taken from the over-man's day-book, and I believe the greatest attention was paid to have the expense correct.

Cultivation of beans and wheat, &c.

	£.	s.	d.	£.	s.	d.
49½ bushels of seed, at 5s. 4d.	13	3	11			
40 acres ploughing and harrowing, at 12s.	24	0	0			
8 days work with drill, at 7s. 6d.	3	0	0			
4 carts two days leading weeds, at 5s	2	0	0			
24 women cutting weeds, at 9d.	0	18	0			
				43	1	11
141 days ploughing and harrowing, at 5s.	35	5	0			
435 days work of women weeding, at 9d.	16	6	3			
45 days work of men, at 2s.	4	10	0			
				56	1	3
168 days work of women cutting, at 1s. 3d.	10	10	0			
30 men's days work, at 2s.	3	0	0			
66 women's days work, binding, at 1s. 3d.	4	2	6			
22 men's ditto, making bands, &c. at 2s.	2	4	0			
				19	16	
27 men and horses leading the beans off the ground, at 5s.	6	15	0			
18 women's days work, at 9d.	1	2	6			
Stacking and leading the beans	7	15	0			
				15	2	6
				£134	12	2
Further expenses after the crop of beans was cut.						
Twice ploughing and harrowing 40 acres, at 12s.	48	0	0			
Ditto 6 acres a third time, at 12s.	3	12	0			
2 carts 6 days, leading off weeds and stones, at 5s.	3	0	0			
48 women picking, at 9d.	1	16	0			
10 men ditto, at 2s.	1	0	0			
				57	8	0

Cultivation of beans and wheat, &c.

Value of crop 628 bushels, at 5s. 4d.				£167	9	4
Expense of sowing, cleaning, and reaping the beans,	£134	12	2			
Had the wheat been then sown, the balance in favour of the crop would have been				75	12	0
				£243	1	4
By further expenses as above	57	8	0			
	192	0	2			
Balance in favour of the green crop, giving credit for the expense of the fallow	51	1	2			
	£243	1	4			

The appearance of the wheat is most promising. It is my intention to take another crop of beans, which will most completely clean the ground, then give a second dressing of from 20 to 30 cart-loads of compost, and sow it with wheat and seeds in the spring.

Should farther information be requisite, I shall be happy to give it.

I am, Sir,

Your obedient servant,

I. C. CURWEN.

Workington Hall, March 20, 1804.

CHARLES TAYLOR, Esq.

DEAR SIR,

An opportunity offering by which I can send you a sample of my beans for the inspection of the Society, I think

think it more advisable than waiting till the meeting of Parliament; should it occur to you that any further information is requisite, I will be much obliged to you to acquaint me with it. I think I may, without arrogating too much, say, the manner in which the crop was worked and got into the ground, and its present appearance, is not inferior to any thing which has been done in any part of the kingdom. The accounts of expense were kept with great care and attention. I shall be highly gratified in being successful in my application for the medal. Should any information be wished by the Committee, my friend, Mr. Greene, of Bedford-square, would willingly attend, as he expressed great pleasure at what he saw whilst we were putting in the crop. It has drawn the attention of the farmers in the neighbourhood; and when I come over it again, I hope they will be sensible of the advantages resulting from the plan. I am this winter trying an experiment in feeding milch cows, and selling the milk to the poor, who have hitherto been extremely ill supplied. I conceive, by feeding the cows with green food and oil-cake, I can furnish the milk as cheap, and with as much profit as in summer. I give each cow four stone of green food, at 1½d. per stone, four pounds of oil-cake at 1d. straw 2d. making the total one shilling. New milk is 2d. per quart—any thing above six quarts is profit. I have thirty cows, mostly heifers; these afford less milk; but I can dispose of them without loss in March or April, having no keeping in summer, or design to interfere with other farmers. I sell near two hundred quarts per day, besides my own consumption, farm-house, &c. &c. The cattle are in admirable order. I keep them in open sheds, and turn them out several hours every seasonable day. The crops here were in general good. I had an acre and three rood of carrots, which produced five thousand stone; the ground was by no means good; but they were sown upon ridges, gathered as high as possible, with a double mould-board plough, and kept well worked during the summer. My success will induce many trials. I give five pounds each day to my horses, instead of oats, which saves me sixty Winchester bushels per week, or £20. The Bishop of Llandaff

Cultivation of beans and wheat, &c.

Cultivation of beans and wheat, &c.

Llandaff is very busily employed planting a hundred acres, mostly with Larch; not to interfere with him, I wait till next year, when I shall plant between one and two hundred acres, lately purchased.

With great respect, I am,

Dear Sir,

Your obedient humble servant,

J. C. CURWEN.

Workington Hall, Nov. 20, 1804.

CHARLES TAYLOR, Esq.

DEAR SIR,

I wish to add to the communication I had the pleasure of making to you, respecting the culture of beans, that I have threshed out two stacks, and found the straw most admirable fodder. Horses are extremely fond of it; and I have, in no instance, found it to disagree with them, which I have understood to be frequently the case when the bean stands till it is quite withered. This advantage in favour of cutting the bean green had not occurred to me, and will add much to the value of the crop, and supply the place of oat straw, which is nearly of equal value with hay. I have not used any hay this season, but given bean and other straw with potatoes and corn, and find the horses in high condition. The experience of every year convinces me of the great saving in my plan of feeding, as well as its being the best food that horses can have for keeping them in condition and health. Lucerne and an equal quantity of corn will not keep the horses in the same condition as with potatoes. It is supposed this feed is not adapted to quick work: I can only say, I seldom travel less than eight miles per hour with my carriage-horses so fed, and I drove them thirty-five miles, a few days ago, in four hours and three quarters, and this without any injury or distress to them.

With respect, I am,

Dear Sir,

Your obedient humble servant,

J. C. CURWEN.

Workington Hall, Jan. 25, 1805.

CHARLES TAYLOR, Esq.

V.

On the Arrangement and mechanical Action of the Muscles of Fishes. By ANTHONY CARLISLE, *Esq. F.R.S. F.L.S.**

IT was my intention to have continued my physiological inquiries on the phenomena of muscular motion, by a series of chemical experiments; and to have communicated the result, when duly matured, to the Royal Society. But an unexpected request, made at a late period, for the Lecture of the present year, obliges me to defer those researches, and to limit the investigation of the subject I have chosen. Introductory remarks.

The application of the motive organs of animals has already furnished examples of general utility by increasing our knowledge of mechanical powers; and the cultivation of this study promises still further improvement. Peculiar structure of fishes.

The muscles of fishes are of a very different construction from those of the other natural classes. The medium in which these animals reside, the form of their bodies, and the instruments employed for their progressive motion, give them a character peculiarly distinct from the rest of the creation. The frame-work of bones or cartilages, called the skeleton, is simple; the limbs are not formed for complicated motions, and the proportion of muscular flesh is remarkably large. The muscles of fishes have no tendinous chords, their insertions being always fleshy. There are, however, semi-transparent, pearly tendons placed between the plates of muscles, which give origin to a series of short muscular fibres passing nearly at right angles between the surfaces of the adjoining plates. Lewenhoeck† appears to have overlooked these tendons, and the numerous vessels, which he describes in the interstices of the muscular flakes, I have not been able to discern. Their skeleton is simple; muscles voluminous. Tendons.

The motion of a round shaped fish, independent of its fins, The motion of a fish

* Read before the Royal Society, Nov. 1805, being the Croonian Lecture.

† Phil. Trans. Vol. XXXI. p. 190.

fins, is simple; and as it is chiefly effected by the lateral flexure of the spine and tail, upon which the great mass of its muscular flesh is employed, whilst the fins are moved by small muscles, and those, from their position, comparatively but of little power, I shall only describe in detail the arrangement and application of those masses, which constitute the principal moving organs.

—explained from the structure of the cod.

For this purpose a well known fish, the cod*, has been selected as a standard of comparison for the muscles of other fishes, there being a conspicuous resemblance among them all.

The side fins and back fins regulate position, &c.

The pairs of fins have been considered as analogous to feet, but they are only employed for the purposes of turning, stopping, altering the position of the fish toward the horizon, and for keeping the back upwards. The single fins appear to prevent the rolling of the body, whilst the tail is employed to impel it forward.

Manner in which the fins act.

Each of those fins, which are in pairs, is capable of four motions, viz. of flexion and extension, like oars, and of expanding the rays, and closing them.

The extension of the whole fin is performed by a single radiated muscle, which is often supplied with red blood: the antagonist is of a similar character. The greater power of the extensor muscle (Vide Plate V. *a*, *a.*) shews how strongly it is required to act when employed to stop suddenly the progressive motion. A series of intervening muscles expand and close the rays.

In the act of extending the fin the interosseal muscles are passive. It is advanced forward edgeways and closed; but during its flexion, the rays are expanded, striking the water with its broadest surface: this action assists the tail in turning the fish. In the effort to stop, these fins are strongly retained at right angles with the body, by the force of the extensor muscles, the rays are expanded, and the effect is assisted by the tail turning laterally with its broadest surface forward.

The single fins, for the expansion and contraction of their rays, are furnished with two sets of muscles; one of which is situated at their roots, and lies oblique;

* Gadus Morhua of Linnæus.

(*bbbbb*) the other, parallel with the spines, to which the rays are articulated (*cc*). The fin has also a lateral motion, by which it is occasionally drawn out of a straight line; and by the co-operation of these muscles on both sides, it is kept steady whilst the body of the fish is turned oblique in swift motion, or in eddies. When placed near the tail, the single fins seem also to aid the effect of that instrument by increasing its breadth.

Explanation of the action of the tail.

The tail is the principal organ of progressive motion, and its actions are performed by the great mass of lateral muscles. There are a series of short muscles for the purpose of changing the figure of the tail fin, which arise from the spine and *coccyx*, and are attached to the rays immediately beyond their joints: (*dd*): their action is to expand the rays, and by partial contractions to alter the lateral position of the fin. Slender muscles are placed between the several rays, (*ee*,) whose office is to converge them previous to the stroke of the tail.

The muscles situated on the head are those, which act on the *membrana branchiostega*, the under jaw, *os hyoides*, *fauces*, and the globe of the eye.

Experiments on the action of fish deprived of their fins.

In order to determine the effect of the fins on the motions of fishes, a number of living dace*, of an equal size, were put into a large vessel of water. The pectoral fins of one of these fishes were cut off, and it was replaced with the others. Its progressive motion was not at all impeded; but the head inclined downward, and when it attempted to ascend, the effort was accomplished with difficulty.

The pectoral and abdominal fins were then removed from a second fish. It remained at the bottom of the vessel, and could not be made to ascend. Its progressive motion was not perceptibly more slow; but when the tail acted, the body shewed a tendency to roll, and the single fins were widely expanded, as if to counteract this effect.

From a third fish, the single fins were taken off. This produced an evident tendency to turn round, and the pectoral fins were kept constantly extended to obviate that motion.

* Cyprinus leuciscus.

From a fourth fish, the pectoral and abdominal fins were cut off on one side, and it immediately lost the power of keeping the back upwards. The single fins were expanded, but the fish swam obliquely on its side with the remaining pectoral and abdominal fins downwards.

From a fifth fish all the fins were removed. Its back was kept in a vertical position, whilst at rest, by the expansion of the tail, but it rolled half round at every attempt to move.

From a sixth fish, the tail was cut off close to the body. Its progressive motion was considerably impeded, and the flexions of the spine were much increased during the endeavour to advance: but neither the pectoral nor abdominal fins seemed to be more actively employed.

From a seventh fish, all the fins and the tail were removed. It remained almost without motion, floating near the surface of the water, with its belly upward.

These experiments were repeated on the roach*, the gudgeon†, and the minnow‡, with similar results.

Differences between the texture of the muscles of fish and other animals.

The muscles of fishes differ materially in their texture from those of other animals: they are apparently more homogeneous, their fibres are not so much fasciculated, but run more parallel to each other, and are always comparatively shorter. They become corrugated at the temperature of 156° of Fahrenheit, when their tendinous and ligamentous attachments are dissolved, and their serous juices coagulated. Under those circumstances the muscles lose their transparency, and the lateral cohesion of their fibres is lessened.

Mechanical arrangement and physiology of the lateral muscles.

But the mechanical arrangement and physiology of the lateral muscles of the body of fishes constitute my present object. These parts have already been described in a general way by Professor Camper, M. Vicq-d-Azyr, and M. Cuvier, to whom I am indebted for much useful information. They have been denominated *couches musculaires,* by M. Vicq-d-Azyr§, and *muscles laterals* by M. Cuvier‖. The term used by M. Cuvier seems very

* Cyprinus rutilus. † Cyprinus gobio. ‡ Cyprinus phoxinus.

§ Mem. étrangers de l'Academ. des Sci. de Paris. Tom. VII. p. 18 et 223.

‖ Leçons d'Anatomie comparée. Vol. I. p. 196.

appropriate

appropriate for the general division or class. But, as the flakes are arranged in distinct longitudinal rows, these rows must be considered as orders. And, as *couches* appears objectionable, I shall adopt *series* in its stead; distinguishing each by a word referring to its situation in the animal, viz. the dorsal, vertebral, abdominal, and ventral series.

These series are composed of thin masses of muscle, or, as they are commonly called, flakes; which for the most part are thicker upon their outward edges, and become wedge-shaped toward their interior attachments. Each series is separated from the next adjoining by a membranous partition, which is most apparent between the vertebral and abdominal series. They are disposed in flakes or series.

The dorsal series (*ff*) arises from the back of the head. In its course it is terminated on the upper edge by the bones, which support the single fins, and a membranous *septum:* at this part the flakes are thin. Its lower margin is bounded by the vertebral series, where the flakes become gradually thicker. The first flake is composed of longer fibres than the rest, and possesses more red blood. Those succeeding it range obliquely backwards. They are all joined together by cellular membrane, and shining fasciæ, which resemble the tendinous expansions in quadrupeds. Particular description.

Toward the middle of the fish the flakes are thicker, and stand more perpendicular to the surface, becoming oblique and thin as they approach the tail; whilst the intervening fasciæ are most dense at each extremity. This series consists of forty-five flakes, a number corresponding with that of the spinous processes to which they are attached, and which does not vary with the growth of the fish.

The muscular fibres constituting each flake, run nearly at right angles with its anterior and posterior surfaces, and parellel to the length and surface of the fish; except that their posterior extremities incline somewhat inwards.

As the skull affords the ultimate fixed attachment of this series, and its moveable insertions are on the vertebræ, and the tail, it follows, that its combined action is to bend the whole body and tail towards one side; or, if

Particular description of the muscles of fishes.

the flakes contract partially, to give it a serpentine motion. To produce these effects all the other series cooperate.

The superior external edges of the flakes of the vertebral series (*gg*) form acute angles with the inferior external edges of those of the dorsal series, the apices of which point toward the tail: the flakes are larger, but their number is the same. The lower margin of this series is bounded by the central membranous partition, which has already been noticed to be more conspicuous than the other longitudinal divisions, and it apparently admits of greater motion.

The abdominal series (*hh*) is composed of flakes similar to the preceding. They range toward the tail, forming an angle with those of the vertebral series, the apex of which is presented toward the head. They are attached internally to the transverse and inferior spinous processes of the vertebræ. The ribs are placed in the line of the centre partition, and lie between the flakes. This series arises from a bone which borders the opening for the gills, and the pectoral fin, with its scapula and muscles, is situated between its foremost flakes. Wherever this series encloses the viscera, its flakes are shallow, and their thickness internally is not much less than at their external superficies.

Lastly, the flakes of the ventral series (*ii*) form acute angles with the abdominal flakes, the points of which incline to the tail. It is attached anteriorly to the *os hyoides*, and the bones of the lower jaw. In its course it is bounded above by the abdominal series, and below by a membranous *septum*, within which the inferior single fins arise. The flakes, that cover the viscera, are shallow; and they lie more oblique as they approach the tail. Both this, and the last described series, have their muscular fibres arranged according to the length and figure of the fish.

Three large superficial nerves (*kk*) passing longitudinally from the head to the tail, in the course of the membranous partitions, give off fibrils at right angles, which bend inwards between each of the muscular flakes. A larger set of ~~nerves are sent~~ from the *medulla spinalis*, one

between

between each flake, the branches of which seem to enter without ramifying there. Another small nerve passing from the head, and running deep-seated, and close to the dorsal spines, crosses and unites with each of the spinal fibrils, and at the junction a remarkable body appears: it is a loose transparent vesicle, about the size of a millet-seed, containing a white substance like the carbonate of lime found in the intercostal ganglions of frogs. This vesicle is included within the sheath of the nerve.

Particular description of the muscles of fishes

The coats of the blood-vessels are of a delicate texture, and easily ruptured. In order, therefore, to secure them from being injured by the violent and sudden actions of the muscles, the principal trunks both of the arteries and veins are inclosed in osseous canals, formed by the bases of the superior and inferior spinous processes; and their first ramifications lie within grooves in the spines. As they pass out to supply the muscles, their branches are immediately subdivided, so that a considerable vessel soon becomes extremely minute.

Fish move with surprising velocity; nearly equal to that of birds.

The rate, at which many fishes move through a medium so dense as water, is very remarkable; their velocity being scarcely surpassed by the flight of the swiftest birds: and although the large proportion of muscles, and their advantageous application, may partly account for the phenomenon, yet the power would be inadequate to the effect, if it were not suddenly enforced; as is evident from the slow progress of eels, and such fishes as are incapable from their length and flexibility, of giving a sudden lateral stroke.

This extreme force is soon exhausted.

But the quickness and force of action in the muscles of fishes are counterpoised by the short duration of their powers. Those accustomed to the diversion of angling, are aware how speedily the strength of a fish is exhausted, for if, when hooked, it be kept in constant action, it soon loses even the ability to preserve its balance, and turns upon its side, fatigued and incapable of motion. This has been vulgularly attributed to drowning, in consequence of the mouth being closed upon the hook; but the same effects take place when the hook is fastened to the side, or tail. This prostration of strength may depend partly on fear, and partly on interrupted

terrupted respiration, since fishes, when swimming rapidly, keep the *membranæ branchiostigæ* closed, and when nearly exhausted, act violently with their gills.

The structure of their muscles forms a contrast to slow-moving animals.

The shortness of the muscular fibres, and the multiplied ramifications of the blood vessels, are probably peculiar adaptations for the purpose of gaining velocity of action, which seems to be invariably connected with a very limited duration of it. Such examples form an obvious contrast with the muscular structure of slow-moving animals, and with those partial arrangements where unusual continuance of action is concomitant.

These doctrines further illustrated.

Since my former communications on the subject of cylindrical arteries*, another instance of their supplying slow-moving muscles, which are capable of long continued action, has been pointed out to me by Mr. Macartney. It is in the muscles, which act upon the feet and toes of many birds, and seems to be an adaptation for the long exertion of those muscles while they sleep, and also when they alternately retract one foot under the feathers to preserve it from the effects of cold.

The muscles of the human body, which perform the most sudden actions, have their masses of fibres subdivided by transverse tendons, or are arranged in a penniform direction. The semi-tendinosus, and semi-membranosus of the thigh are thus constructed; the former having its fleshy belly divided by a narrow *fascia*, and the fibres of the latter being ranged in a half-penniform manner. The *recti abdominis* are also divided into short masses by transverse tendons, and all these muscles are conjointly employed in the action of leaping.

Perhaps these observations may indicate the reason for that diversity in the lengths of various muscles, which act together; thus, organs of velocity are joined with those of power, and mutually co-operate to produce a simultaneous effect.

DESCRIPTION OF PLATE.

Explanation of the engraving. Pl. V.

The drawing was made from a cod which had been coagulated by heat, in a case of plaister of Paris, the skin being

* Phil. Trans. 1800, p. 98.—Also 1804, p. 17.

being taken away, and an equal portion of the flakes carefully removed from each series, to exhibit their several directions. The subject was reduced to the present size by accurate measurements.

aa, Muscles which extend the pectoral and jugular fins.

bbbbb, Oblique muscles, which erect the rays of the single fins.

cc, Muscles which depress the rays.

dd, Muscles which extend the rays of the tail.

ee, Interosseal muscles, which close the rays.

ff, The dorsal series of muscular flakes.

gg, The vertebral series.

hh, The abdominal series.

ii, The ventral series.

kkk, Three superficial nerves which run longitudinally between the series of flakes.

l, Posterior surface of a dorsal flake.

m, Posterior surface of an abdominal flake.

n, Anterior surface of a vertebral flake.

o, Anterior surface of an abdominal flake.

The middle portion of the fish from whence the flakes have been removed, shews the several directions of them, and also their different thicknesses. The spine appears in the chasm.

VI.

On the Use and Abuse of Popular Sports and Exercises, resembling those of the Greeks and Romans, as a National Object. By Samuel Argent Bardsley, *M. D.*

[From the Memoirs of the Manchester Society, Vol. I.]

Recreation or amusement

HUMAN nature is so constituted as to require both bodily and mental recreation. This instinctive propensity to amusement in man, is sufficiently proved by the universality of the appetite, in every stage of life, under every variety of clime, and constitution of government. But the regulation of this natural propensity differs greatly

ly according to the circumstances under which he is placed. The recreations and sports of mankind are therefore diversified by the influence of moral, political and physical causes. The means of gratification are various and complex: the end simple and uniform. To escape from the sensations which may be induced by too great or too little exertion of body or mind, and to enjoy the pleasure which sympathy extracts from the varied intercourse with fellow man, give rise to that fondness for public diversions and sportive contests, so conspicuously displayed in the history of mankind.—The influence of physical causes, in regulating the nature of these diversions, may be readily conceived.

—is sought by man in order to change his state of re-action.

Influence of physical causes affect our amusements. Activity is seen in a cold climate, indolence in a hot one.

The hardy, strenuous and active amusements of the inhabitants of the temperate and frigid zones, would depress and exhaust, rather than enliven and invigorate, the residents of a torrid clime. Hence the supreme delight of the Asiatic consists in the enjoyment of those pleasures which are purchased with little fatigue of body, or agitation of mind. To inhale the grateful fumes of his pipe, and to foil his adversary in the stratagems of chess, or other sedentary games, constitute the principal part of his amusements.

Moral causes act likewise.

Although physical causes necessarily circumscribe the sphere of man's active pursuits, yet they have much less controul than those of a moral and political kind. Man is endued above all other animals with a frame and constitution which can adapt itself to every diversity of clime and change of temperature. He can, in a measure, subdue physical obstacles, when powerfully stimulated by moral and political causes.—The savage, compelled to hunt his prey for food, has little leisure to cultivate his intellectual taste and powers. If not exposed to danger from hostile neighbours, his recreations are mostly of a negative kind.—He is happy when idle and at ease. But if he be stimulated by the prospect of war, all his amusements tend to accomplish him for carrying on successfully his military exploits. His songs are praises of the heroes of his nation; and his dances are connected with martial discipline. The public shews and festivals

of

of his country are, almost without exception, of the character of savage war*.

Civilization encourages mental recreation

According to the degree of civilization will the public sports and amusements of a people partake more or less of the mixed character of corporeal and mental recreation. A display of the arts which refine and gladden life, can only flourish where the condition of man has been long meliorated by the enjoyment of moral and political advantages.—Indeed the kind and nature of the popular sports and exhibitions of a people, whether just emerging from barbarism, or passing through the various stages of improvement, or arrived at the highest pitch of refinement, serve to measure, as by a scale, the different degrees of their advancement to the acme of civilization. The two most powerful and celebrated nations of antiquity, Greece and Rome, afford ample proofs of the truth of this remark. The shews and public sports of each of these nations, while they issued from their character and manners, operated on this very character and manners, and rendered them more ardent and permanent. This connection between the character of a people and their sports, was forcibly impressed on their legislators and rulers. Their public games were instituted for other purposes than mere amusement and relaxation. They were rendered subservient in Greece to the noblest views of legislative policy. Intimately connected with the whole system of government, whether civil, military, or religious, they had a moral as wellas a political tendency. To promote ardor, emulation, friendship, patriotism, and all the animated principles and connections of active life, the Olympic and other solemn festivals were instituted. In

Whence the state of barbarism or refinement may be measured from the public sports.

Legislators have often directed the public sports to moral and political objects.

* The savage tribes of America furnish various proofs of the truth of this remark.——Likewise in Collins' account of the natives of New Holland, there is a curious illustration of the propensity of a rude and savage people to those amusements which are adapted to their peculiar situation.

Indeed the singular and ludicrous ceremony of initiating youth into the rank of warriors, at the celebration of their military exercises and games, is a striking instance of that disposition to amusement, which even the most savage and wretched state of life cannot eradicate.

order to investigate some of the moral and political effects of these popular sports and public games, which contributed so largely in raising the Greeks and Romans to a height of unparalleled grandeur, it will be necessary to examine the foundation of a system, which, in some respects, when freed from its worse abuses, particularly those which the more ferocious character of Rome introduced, may not illaudably nor unusefully be imitated by the most civilized nations.

The ancient Greeks directed their sports to afford pleasure and to give agility and personal power.

Though it may, perhaps, be admitted, that the difference in the state of knowledge and general policy, in the ancient and modern world, will not admit of a close approximation in the system of their public sports and amusements; yet the principles to which the Greeks directed their attention in controuling popular amusements deserve the limited imitation of every free and enlightened people. For, their aim was to direct to innocent and useful objects two of the most powerful principles of the human breast;—the love of pleasure and the love of action. Hence arose the institution of the * gymnastic exercises, which formed the principal part of all the solemn games. The gymnastic art consisted in the performance of bodily exercises calculated for defence, health and diversion. That branch of these exercises, called the athletic or sportive, must be considered as coeval with the formation of society †. The five ‡ gymnic exercises, so

The athletic sports are practised by all nations.

* Lycon, according to Pliny, first instituted the gymnastic games in Arcadia, whence they were extended throughout Greece and successively contributed to the highest gratification of both the Greeks and Romans, in their private schools and public solemnities.

They were performed in the *Gymnasium*, where not only youth were instructed in these exercises, but also the philosophers taught their different doctrines.—The Palæstra, which formed a part of the building, was the school for the gymnic exercises.

† In almost every island of the Great Pacific Ocean, we find a similarity, more or less striking, in the athletic and warlike exercises of the natives, with those practised in Greece.

‡ These five exercises were called Pentathlum by the Greeks, and Quinpertium by the Romans. They consisted of leaping, running, throwing the Discus, darting the javelin, and wrestling; but instead of darting the javelin, others mention boxing. The last exercise

so accurately described by Homer, Pindar, Sophocles, and Pausanius, formed the principal branch of the education of youth.

How the Greeks were educated.

To be enabled to excel in the performance of these, they were trained with the greatest care; and every means was employed to excite powerful emulation. Their object was, to recreate and strengthen the body, as well as fortify and exalt the mind. For, the firm organization acquired by perpetual exercise, counteracted the propensity to vicious indulgence, which a voluptuous climate naturally inspires.

Animal vigour gives courage.

They likewise infused a courage depending on animal strength and vigour, which was excited to the highest pitch among this warlike people *. Besides, the ambition of honest fame (the sure † reward of excellence in these sports and contests) taught them to controul the appetites of the body by the affections of the soul.

—and renders men capable of defending their country by military art.

But the chief aim and end of the institution of athletic gymnastics among the more warlike states of Greece, were, perfection in the military character. Their philosophers inculcated this doctrine by their precepts and example.—Plato, in his book of laws, after having viewed the high importance of acquiring bodily force and agility, adds, "a well governed common-wealth, instead of prohibiting the profession of the athletic, should, on the contrary, propose prizes for all who excel in those exercises, which tend to encourage the military art."—And, perhaps no better plan could have been contrived to foster a warlike spirit amongst a people devoted to military enterprize, than the training of youth in these hardy and laborious exercises, and in proclaiming rewards for those

ercise was combined with wrestling; and then took the name of Pancratium.——See Hieronymus Mercurialis, de arte gymnasticâ —and Potter's Archœologia.

* Hac arte, Pollux & vagus Hercules
Innixus, arces attigit igneas.—Hor.
" Thus mounted to the towers above,
" The vagrant hero, son of Jove."

† Such as gained victories in any of these games, especially the olympic, were universally honoured, and almost adored.——See Plutarch's Sympos. lib. II. Quest. VI. and Potter's Archæol.

Mere strength or animal courage is attended by ferocity.

who excelled in their public exhibition. If man were only destined to conquer and triumph over the weaker and less valiant of his race—if the lust of dominion were the only appetite worthy of gratification, then the cultivation of bodily prowess and ferocious courage would properly form the business, as well as pleasure of life. But man has a nobler part to act in society; and enjoyments more pure, lasting, and better fitted to the dignity and character of his nature, become necessary to his well being in an advanced stage of civilization. It may readily be conceived, that those arts which sooth and embellish human existence, and which depend on the cultivation of feeling and of taste, would be neglected by the Greeks, when only bodily strength, activity, and address could carry off the palm of victory. In the distracted state of the first settlers in Greece, when the bodily energies were constantly in action, courage and personal strength decided the day in most of their military conflicts. Hence courage became associated with every idea of patriotism, honour, and virtue. It is the opinion of Aristotle, "That the nations, most attentive to the formation of the body, strive to give it too athletic a habit, which injures the beauty of the shape, and stints the growth of the person. The Lacedemonians avoid this error; yet, by imposing excessive labour on the body, they engender ferocity in the mind, thinking this conducive to martial spirit. But mere warlike courage, taken separately by itself, is a doubtful and defective quality, and, cultivated too assiduously by the hardening discipline of toils and struggles, will degrade and debase the *man*, blunt his faculties, narrow his soul, and render him as bad a soldier as he is a contemptible citizen *." This necessity of rendering the gymnastic art subservient to nobler pursuits, was felt and acted upon by the Athenians, and other polished states of Greece.

Men who have only animal strength and ardour will not be good soldiers.

The Greeks cultivated poetry and music as part of their public games.

The cultivation of poetry and music was encouraged by bestowing the highest honours and rewards on those who excelled in these delighful arts at the celebration of all the public games. To such a happy combination of

* Gillies's Aristot. polit. p. 250.

mental

mental with corporeal excellencies, cherished and displayed under the most pompous and fascinating appearances in their popular diversions and solemn festivals, may the splendid achievements of this distinguished people be attributed *. Considered in the light of affording amusement, exciting generous emulation, and of creating robust and hardy citizens, endowed with energy to resist slavery at home, and enemies from abroad, the gymnastic exercises, with some exceptions, and under proper regulations, are worthy of the admiration and imitation of all free and civilized states. But there was another kind of popular sport, common to the less polished states of Greece, and which has been practised by mankind, not only in the rude and barbarous, but (to the disgrace of humanity) in the most advanced and polished period of civilized life. This amusement depended on the contests of ferocious animals, whose natural antipathies were made use of, and designedly inflamed to gratify a depraved and barbarous taste.—" They delight," says Lucian, (speaking of the Greeks,) " to behold the combats of bold and generous animals, and their own contentions are still more animated."—The savage ferocity inspired by the frequent repetition of such barbarous exhibitions, accounts in some measure for the conduct of the Ephori of Sparta, who, when they declared war against the Helots, ordered that the young bull-dogs should be employed in

Public sports, consisting in the contests of ferocious animals; which are depraved and barbarous.

* Montesquieu is of opinion, that the want of employment for the majority of the citizens, compelled the Greeks to become a society of athletic and military combatants; for, he observes, " they were not permitted to follow the ordinary occupations of agriculture, commerce, and the baser arts; and they were forbidden to be idle; consequently, their only resource was in the gymnastic and military exercises." But this assertion is contradicted by the practice of some of the Grecian states. We know that in Athens commerce was highly esteemed and successfully cultivated. This writer must therefore be understood in a restrictive and qualified sense, when he says, " Il faut donc regarder les Grecs comme une societé d'athletes & des combattans."—Montesquieu de l'esprit de loix. liv. IV. chap. VIII.

The Pancratium, in which the antagonists voluntarily threw themselves on the ground, and annoyed each other by pinching, biting, scratching, and every kind of savage attack, ought not to be endured in a civilized country.

worrying

worrying these miserable slaves. To the Greeks may be attributed two barbarous diversions, which have been eagerly adopted by succeeding nations. The fighting of cocks, and the diversion of bull-fights. The former was first introduced by Themistocles, as a religious festival:—it soon degenerated into a sport for the gratification of avarice and cruelty. The latter had its rise in Thessaly, and was afterwards transported to Rome by Julius Cæsar*.

Cock fights. Bull fights.

The Roman games carried beyond those of Greece.

To Greece, Rome was indebted for almost every institution of popular sports and bodily exercises;—but the Romans carried them to a height of splendour and magnificence unknown to their first inventors. The Circus and Amphitheatre of Rome, exhibited, on a scale proportioned to the immense extent and power of the nation, all the popular sports † celebrated at the Grecian solemnities. In their gymnasia, youth were likewise carefully instructed in the gymnic exercises, and likewise the athletic combatants trained up for public exhibition:—But the barbarous policy of the state, or rather the rude and ferocious manners of the people, gave rise to the alliance of bloody shews and combats, with manly sports and exercises. A gloomy and ferocious superstition, operating on the minds of a people inured, like the Romans, to foreign warfare and intestine broils, suggested the practice of shedding the blood of captives, as a grateful sacrifice to the *manes* of illustrious warriors. This practice, at first a superstitious rite, became a ceremony of more pomp and ostentation at the obsequies ‡ of distinguished persons. Hence the origin amongst the Romans of the profession of a gladiator—and when the

They were more gloomy, ferocious, and cruel.

Combats of gladiators.

* See Pegge's Dissertation on Cock-fighting in the Archœologia Brittan., and Potter's Antiquities of Greece.

† The Ludi circenses, or circensian games, included all the diversions of the Circus, viz. The Pentathlum, or Quinquertium, chariot races, Pyrrhic dance of the Greeks, to which were added sports of Roman origin.—The Naumachia, or sea fights, and bloody combats of gladiators, and the contests of ferocious animals with each other and with man.

‡ The first shew of gladiators was instituted by Marcus and Decius Brutus, on the death of their father, in the year of the city, 490.—See Kennet's Antiquities of Rome.

people

people had once acquired a taste for bloody exhibitions, the detestable spectacle of gladiatorial combats was presented for their amusement.

The progress of cruelty and the danger of gratifying barbarous propensities, cannot admit of more striking illustration than what is afforded by considering the effects of these savage exhibitions on the manners and character of the Romans.

This is not the proper place to discuss the question of *Right* or *Expediency*, which man has always claimed of rendering subservient to his wanton sports, the lives and feelings of the brute creation. It will come with more propriety under discussion in the sequel of these observations.—But it may not be improper, at present, to animadvert on the consequences of rendering bloody scenes familiar and amusing to even an enlightened people.

Conflicts of wild animals with men—

The frequent spectacle of animals* conflicting with each other in the games of the Amphitheatre, gradually hardened the public mind, and begat a necessity for diversions of a more animated and dangerous kind.—Men were encouraged, and even compelled to enter the lists with wild beasts. At first, condemned criminals forfeited their lives in these contests. But these were not sufficiently numerous to gratify the appetite of a degraded and licentious people. Men † were professedly instructed and regularly hired to sell their blood, like gladiators, in these bestial contests. Such enormities, great as they are, hide their diminished heads before the supreme wickedness and cruelty of *gladiatorial* exhibitions. When the susceptibility to humane and tender feelings became almost extinct by the bestial encounters, it became neces-

— first criminals, and afterwards men professionally instructed, &c.

* In the shew of wild beasts exhibited by Julius Cæsar in his third Consulship, twenty elephants were opposed to 500 footmen, and 20 more with turrets on their backs (sixty men being allowed to each turret) engaged with 600 foot and as many horse. There were three sorts of these diversions, under the common title of Venation. The first, when the people were permitted to run after the beasts and catch what they could for their own use—the second, when the beasts fought with one another; and the third, when they were brought out to engage with men.—See Kennet's Roman Antiquities.

† These were called Bestiarii.

These enormities extended to all ranks, and even to women.

sary to gratify their depraved appetites by the exhibition of human butchery and sacrifice. So lost to every spark of decency and humanity were this infatuated and ferocious people, that the highest ranks of society gloried in voluntarily taking a part in these encounters: and even the softer sex, throwing aside every trait of amiable modesty and timidity, were ambitious of displaying their personal courage in these savage contests. This conduct did not escape the lash of the Roman satyrist.

" Cum ——— Mævia Tuscum,"
" Figat aprum, & nuda teneat venabula mammâ."

Persons of every age, sex, and condition attended these barbarous sports. The intoxication of the populace, from frequent gratification, arose to such a pitch, that streams of blood flowed annually from several hundreds, perhaps thousands, of the wretched gladiators, throughout the various cities of the empire. When the people had been so far steeped in blood as to prefer beyond any other these sanguinary combats, all the candidates for high offices bribed their favour, by outvying each * other in the number and pomp of these impious shews. Even the most powerful and enlightened minds among the Romans were tainted by the contagious influence of custom and the strength of national prejudice: Cicero, the humane and dignified statesman and philosopher, very faintly, if at all, disapproves of the excessive fondness of the people for this abominable exhibition in his time; and plainly expresses his approbation of the practice as antiently conducted. His words are, " crudele gladiatorum spectaculum & inhumanum nonnullis videri solet; & haud scio an ita sit, ut nunc fit: cum verò sontes ferro depugnabant, auribus fortasse multæ, oculis quidem nulla poterat

These habitual cruelties vitiated even the minds of their philosophers.

* Julius Cæsar, in his Edileship, presented three hundred and twenty pair of gladiators—and Trajan, as averse from cruelty as the former, brought out 1000 pair of gladiators during a solemnity of 123 days. But the sanguinary hero enlisted 400 senators and 600 knights (if there be not a corruption of the text of Suetonius, the historian) as gladiators, at a celebration of the Circensian games.—See Gibbon's History of the Decline and Fall of the Roman Empire.

esse

esse fortior contra dolorem & mortem disciplina."—"The shews of gladiators to some persons may seem barbarous and inhuman: and I don't know as the case now stands that the censure is unjust:—But when only guilty persons were the combatants, the ear might receive better instruction—it is impossible, however, that any lesson to the eye can better fortify the mind against the assaults of grief and death." A ridiculous and inhuman assertion (an eloquent historian exclaims) admirably confuted by the bravery of antient Greece and modern Europe.

Absurd and inhuman argument.

Indeed so little was the practice connected with military ardour and true courage, that before its establishment the Romans were, perhaps, more distinguished for bravery, steadiness of discipline, and contempt of death, than at any subsequent period of their history.

The Romans did not improve in military spirit;—

It is, however, certain, that in proportion to the frequency and extent of these bloody exhibitions, did the military valour and discipline of the Romans sink into a state of degradation and contempt. "After subsisting a period of 600 years" (according to the remark of Gibbon), "Honorius gave the final blow to this inveterate abuse, which degraded a civilized nation below the condition of savage cannibals."

— but became degraded in these times of cruelty.

Rome justly suffered moral and political evils from fostering such inhuman propensities: her existence was more than once at stake by the insurrection of the wretched and despairing victims of her barbarity. Besides, the corruption of the populace, through the medium of these diversions, was no difficult task to the powerful and wealthy. When man has been taught to subdue the humane feelings of his nature, he contracts an indifference to the purer and nobler virtues which fit him for discharging the duties of a good citizen. Indeed every habit that wears out the sympathizing sensibility of the heart, proportionably disqualifies man from exercising the pleasing duties and tender charities, connected with public and domestic life.

Danger of insurrection.

It would appear from this hasty sketch that the popular games and exercises of the Greeks when compared with those of the Romans, were better calculated to promote the social as well as individual welfare of mankind.

The Grecian sports had good effects; the Roman, the contrary.

The Grecian sports fortified the body and disciplined the mind, without injuring the one or brutalizing the other.

Universal depravity accompanied the latter;

Indeed the superior wisdom of Grecian policy rendered the public diversions subservient to the interests of the state as well as to the happiness of the people. The Roman government did not always neglect this branch of policy. For, their sports, in the early and rude state of the nation, were adapted to the circumstances in which the people were placed. But incessantly harassed themselves, or employed in harassing others, they had neither leisure nor inclination to cultivate those arts which contribute to liberal amusement: ever occupied with warfare, all their amusements had a warlike tendency. The contests of savage animals and the conflicts of gladiators, suited alike the ferocious manners of the populace and the political views of their rulers. When the empire had subdued more polished nations, it might have been expected, that its amusements would have assumed a different spirit and complexion. But the habits of the people were too deeply rooted and depraved to be easily changed—And, indeed, so far were their rulers from wishing to accomplish this reformation, that, from corrupt and selfish views, they studiously excited the propensities of the people toward degrading and inhuman shews, by administering constant food for these savage enjoyments.

— which was not changed by intercourse with more polished nations.

Modern civilization has bettered the condition and manners of society;

In the progress of civilization, since the downfal of the Roman empire, great and important changes have taken place in Europe, with respect to religious, political, and civil institutions. The melioration of the condition of man in his social and domestic state, and the general refinement of his character and manners, have been the happy result of these moral and political revolutions. Yet still there remain sufficient vestiges of antient barbarity to throw a dark shade on the present state of improved civilization. The cruel sports still so highly relished in many parts of modern Europe, and which bear so near a resemblance to the savage contests of the Circus, exhibit lasting and disgraceful proofs of the relics of antient barbarism. Our own country has been but too justly stigmatized, even by her less polished neighbours,

— but barbarity still remains;

for

for the devotion of the lower ranks of the people to those amusements which are derived from the sufferings of the brute creation.*

Although the resemblance (whether it be original or imitative is of little importance) between the cruel diversions of England and of Rome, may be considered a subject of just regret; yet the similarity in some of the manly exercises and hardy sports, practised by the two nations, cannot but claim our warm and just admiration.

Especially amongst us; but they are mostly athletic.

If we have retained more of the barbarous sports of antiquity than the rest of Europe, there is the merit due to us of having more extensively adopted and practised those amusements and exercises, which inure the body to labour and fatigue, and inspire the mind with courage and emulation. In treating on the general character and spirit of some of the sports and exercises of the people of England, it will not be necessary to enter into particular detail. It is only proposed to hint at those of a popular nature, and which seem to be interwoven with the customs and manners of the mass of the people. They may be comprised under two heads.

1st. The sports which are derived from the animal creation.

2d. The amusements which depend upon bodily exercises and personal contests.

British sports, contests of animals.

I. It cannot be denied, that mankind, at every period of society and under every diversity of country and government, have rendered the animal race subservient to their wanton and cruel sports. But the universality and antiquity of a practice, founded on inhumanity and impolicy, are inadequate to sanction its utility and continuance. If it can be shewn that barbarous sports tend to brutalize the human character, and are inconsistent with the manifest intentions of Providence; the argument derived from long custom and authority must fall to the ground. There is a sympathy implanted in our natures, which renders us feelingly alive to the pains and pleasures of our fellow-creatures, and is even extended to every part of the animal creation. Upon the due exercise of this principle depends great part of our social and individual happiness.—Whatever then has a tendency to

 diminish

Cruelty to animals will destroy the general sympathy of man;

diminish the influence of this principle, ought carefully to be avoided. Now every single act of cruelty contributes its share toward the weakening or extinguishing the principle of sympathy; and by the repetition of such acts, according to the general laws of habit*, a disposition to cruelty is likely to be generated. If a child be early indulged in sportively tormenting *animals*, and this vicious propensity be suffered to grow up into a habit, his sensibility to *human* suffering will be proportionably diminished; insensibility will harden into brutality; and at length he will not be restrained from positive acts of cruelty toward his own species, whenever goaded by the feelings of interest or of passion. Hogarth, our great moral painter, has admirably illustrated the progress of cruelty in the human breast. The first stage of his hero's career is marked by sportive and wanton barbarity to animals. Upon this foundation crimes are soon erected; and at length grown callous to every social † and moral feeling, he closes his profligate career, by the perpetration of a deliberate and cruel murder. Another excellent judge of the human heart, Dr. Moore, has forcibly depicted the effects of wanton cruelty to the inferior crea-

— and render him callous to every proper feeling in society.

Illustrations by Hogarth and Dr. Moore.

* "The habitude which the people of this country (viz. Cape of Good Hope) necessarily acquire in witnessing instances of cruelty on human as well as brute creatures, cannot fail to produce a tendency to hardness of heart, and to stifle feelings of tenderness and benevolence. In fact, the rigour of justice is seldom softened with the balm of mercy."—See Barrow's Travels in Africa, Vol. II. p. 41.

† Such is the general impression on the mind of the power of habit to generate cruelty, that in most countries, those occupations which employ men in the destruction of animal life for the sustenance of human kind, are held in degradation and contempt. The lowest of the butchering tribe, in default of an executioner, is compelled to perform his functions in France and many other parts of the continent. There is an opinion prevailing in England, that butchers, and even surgeons, are equally disqualified, by the nature of their occupations, to sit upon juries, in trials affecting the lives of their fellow-subjects. This is probably a popular error; or, if true, yet a much more honourable reason may be assigned, why surgeons are not required to act in the capacity of jurors. Their office is to administer to the sufferings and calamities of their fellow-creatures—and it is fit they should every moment be disengaged and free to obey the summons to so humane a duty.

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tion, in the character of Zeluco. The feelings of humanity became stifled in this monster's breast, from an early gratification of his caprice and passion in sporting with the torments of the animal race. It is likewise our duty as well as moral advantage—to refrain from all acts of wanton cruelty to the brute creation. The organs of sensation in all the inferior animals, are evidently adapted for receiving and transmitting impressions of pain and pleasure,—and although deprived of speech, their groans and cries are intelligible indications of their painful feelings. Nor are animals less capable of expressing signs of pleasure, as well as of suffering. This provision for the gratification of their several senses, is a sufficient proof of the intentions of the Creator. Like man, they were formed to feel and to enjoy. Here rests the foundation of their natural right to protection and humane treatment from mankind.

The system of nature requires that animals should be destroyed;

It cannot be inferred from this mode of reasoning, that animal life should in every instance be held sacred. The laws of nature and necessity demand from us the painful sacrifice.—Man must destroy life in order to live. Besides, we must consider that if man had subsisted only on vegetable food, the majority of the animal race which furnish his table would never have enjoyed life. Instead of increasing the breed of animals, he would have been compelled to destroy them to prevent a famine.—But barbarously, wantonly and deliberately, to torture and destroy animal life, is equally repugnant to humanity, duty and the best interests of mankind. Experience teaches us, that the common sense and feeling of mankind, condemn that man whose greatest delight seems to consist in bloody and barbarous sports.—Youth, it must be observed, commonly inflict pain on animals in mere sport without a due knowledge of the evil they commit. And the ignorant populace frequently err from the same cause. They are led to consider, but too often, from the connivance and even encouragement of their superiors in knowledge and station, that the animal race are equally indifferent to pleasure or pain; and only created for the purpose of gratifying the appetite, or contributing to the diversion of mankind.

—but not with the wanton infliction of torture.

If

Question. Whether all sufferings inflicted by man or animals are to be condemned?

If the question be asked,—"Whether all sports derived from animal suffering be entitled to equal condemnation?" The answer is decidedly in the negative.—For, although perhaps none can be completely justified, yet there is still a wide difference in the degree of moral and physical evil resulting from their practice. That class of diversions pursued for the benefit of health and exercise, where the enjoyment of pleasure springs from the exertion of our active faculties, must not be compared with those depraved and cruel sports, which merely consist in the torture and destruction of the animal. In the present state of society, active diversions become almost necessary to the well being of the opulent and sedentary classes of mankind. Man cannot be happy without occasional active employment. He pines in the lap of ease and pleasure, and requires the stimulus of animated exertion.—Hunting in all stages of society has therefore formed a principal share of the business and pleasure of man. But in this kingdom especially, a considerable portion of its inhabitants devote part of their time to the active and vigorous pursuits of the chace. And although it may be urged in favour of this exercise, that it invigorates the spirits, teaches men to despise enervating pleasure, and inures them patiently to sustain hunger, cold and fatigue; yet it cannot be denied, that it has a tendency, when too eagerly pursued, to blunt the sensibility,—to render the manners rude and coarse, and thus to degrade the dignity of the human character. The man of enlarged understanding, liberal notions and elegant manners, may occasionally call in the aid of the chace to relieve the fatigue of sedentary employment, or renovate the powers of nature, exhausted by mental exertion, without much apparent injury to his manners or morals;—but *frequently* to take pleasure in that, by which misery to animals is inflicted, if not absolutely vicious, is yet of no good tendency; it conduces neither to form the gentleman nor the man.

Apology for hunting.

If it be considered as too nice and fastidious a delicacy to impute blame to the practice of destroying animals for the purpose of health, exercise and recreation, it may, however, be allowed to call in question the policy and humanity

humanity of other diversions, once highly cherished, and still too much practised by the people of this country. Some of these national sports are sanctioned by the practice and encouragement of many persons distinguished for rank and talents.—That there should be found such abettors of the bloody and barbarous diversions of *cock-fighting* and *bull-baiting,* is both a subject for surprise and regret.—These two amusements seem to have survived the destruction of many other sports equally as unmeaning and barbarous; but that they should not have entirely yielded to the improved state of manners—or the interference of the laws, is a subject of just reproach to us by foreigners, and of deserved reprobation by the humane and reflecting of our own countrymen. The reciprocal influence of sports and manners on each other, may be shown from these and similar diversions, as practised in various periods of our history. A late ingenious and laborious writer* has described the ancient and modern diversions of the people of Great Britain, from the earliest authentic records to the present time.—This picture confirms the general truth of the position:—That as a nation improves in manners and civilization, it loses its high relish for inhuman and ferocious diversions. It is more than probable, that the sports derived from animal contests, such as bull-baiting, bear-baiting, and cock-fighting, are vestiges of Roman amusements introduced by that people into this conquered island. It is at least certain they were practised † in the early period of

Cock-fighting and bull-baiting condemned

* See Strutt's Diversions and Pastimes of the People of England.

† The jongleurs or jugglers, in the reign of Henry the 2d, made a profession of training bulls, bears, and even horses, for the purpose of baiting them with dogs.—The sport of fighting cocks in pitched battles, first appears on record in the same reign. During subsequent reigns this sport became general; and to the disgrace of our country was countenanced by royal favour during James the 1st and Charles the 2nd's reign. If the Romans set us the example in devising these sports, it must be confessed, we have "bettered the instruction." For to English refinement and ingenuity may be ascribed the noble invention of the Gaffle or Spur; by the aid of which, the gallant combatants of the cockpit mangle, torture and destroy each other; no doubt to the great satisfaction and delight of

of our history. During the military enthusiasm of the middle ages, while jousts and tournaments furnished amusement to the nobility and gentry, martial exercises constituted the chief diversions of the body of the people.

Science of defence. Prize fighters or English gladiators.

Hence arose the establishment of schools for teaching the "Noble science of defence," as it was called. These laid the foundation for professed gladiators, or prize-fighters.—The great prevalence of murder, robbing and every species of barbarity, in consequence of these proceedings, during the reign of Edward the First, compelled the government to issue an edict to suppress the schools as well the combats of prize-fighters.

During the reign of Henry the Seventh and Henry Eighth, these schools were revived in consequence of a supposed degeneracy in the military spirit of the people; and the baiting of animals at the same time became a favourite * diversion.

The bear garden.

The Bear-garden †, during the 16th and the early part of the 17th century, was the place of rendezvous for the highest as well as the lowest classes of society. The Tatler, when treating on the barbarous sports of this national circus, and the comments of foreigners on the subject,

of admiring spectators. Another instance of our barbarous ingenuity must not be omitted. No other nation but the British has contrived to put in practice the *Battle-Royal*, and the *Welch-Main*.—In the former, the spectator may be gratified with the display of numbers of game-cocks, destroying each other at the same moment without order or distinction. In the latter, these courageous birds are doomed to destruction in a more regular, but not less certain manner. They fight in pairs, (suppose 16 in number) and the two last survivors are then matched against each other; so that out of 32 birds, 31 must be necessarily slaughtered.—See Pegge's Essay on the Archœlogia Britannica.

* Stephen Gossen, in the latter end of Henry 8th's reign, considers that our ancestors had entirely sunk into the lap of effeminacy, as may be proved by the following singularly quaint and alliterative style of abuse. "Our wrestling at arms is turned into wallowing in ladies' laps; our courage to cowardice; our running to riot; our bows into bowls; and our darts into dishes.

† Another common diversion, during the period of Queen Elizabeth and in the two following reigns, consisted in several persons at the same time scourging with whips, a blind-folded bear round the ring, whose sufferings and awkward attempts at revenge highly gratified the noble, as well as ignoble spectators.

adds,

adds, "I wish I knew how to answer the reproaches which are cast upon us, and to excuse the death of so many innocent cocks, dogs, bulls and bears, as have been set together by the ears, and died an untimely death only to create us sport." Bull-baiting was not confined within the limits of a bear-garden, but was universally practised on various occasions, in all the towns and villages throughout the kingdom. In many places the practice was sanctioned by law, and the bull-rings affixed to large stones driven into the earth remain to this day, as memorials of this legalized species of barbarity. The regular system of bull-baiting seems to have commenced with the reign of King John. Its general prevalence since that period, until within a few years, must have produced important effects on the manners and character of the people. The misery it has inflicted on the harmless and inoffensive brute, is a matter of no small regret and indignation with the humame and considerate part of mankind;—but the injury done to public morals and social huppiness, by an attachment to this degrading pastime, is still more to be deplored. Numbers of bulls were, and still continue to be, regularly trained and carried about from village to village, to enter the lists against dogs bred up for the purpose of the combat. To detail all the barbarities committed in these encounters would be a disgusting and tedious task. All the bad passions which spring up in ignorant and depraved minds are here set afloat. The torments and blood of the suffering beast, are purchased by money of his unfeeling master; and the owners of the dogs are not more gratified in gaining their sanguinary wagers, than in applauding the savage ferocity displayed by these animals. We cannot often appeal to the annals of bull-baiting;—but if they were regularly laid open, it is probable that many instances of a similar kind to the following might be held up as a lesson to the abettors of such diversions.—* "Some years ago at a bull-baiting in the North, a young man, confident of the courage of his dog, laid some trifling wager, that he would at separate times cut off all the four feet of his dog, and that after

Bull-baiting still continues

to degrade the public morals and disgrace the nation.

Detestable barbarities practised by the followers of this sport.

* See Bewick's Quadrupeds.—Article Dog.

every amputation he would attack the bull. The cruel experiment was tried, and with success." Such detestable barbarity can only be exceeded by the following recital extracted from the public prints of 1799. At a bull-baiting in Staffordshire, after the animal had been baited by single dogs, he was attacked by numbers let loose at once upon him.—Having escaped from his tormentors, they again fastened him to the ring; and with a view either of gratifying their savage revenge, or of better securing their victim, they actually cut off his hoofs, and enjoyed the spectacle of his being worried to death on his bloody and mangled stumps. These facts speak more than a volume against the sophistic arguments of the advocates for exciting brave and manly courage by the exhibition of bloody and barbarous sports.

[To be concluded in our next.]

VII.

Remarkable Effect of the Effluvia from Ammonia Muriate of Platina on the Eyes, Nostrils, Throat, and Lungs, as in a Catarrh. In a Letter from An Occasional Correspondent.

To Mr. NICHOLSON.

SIR,

Effects not hitherto noticed

I DO not know that the following effects of the effluvia of precipitate of platina by muriate of ammonia, i. e. of ammonia muriate of platina, have been observed; and whether or no these are like those from the effluvia of ipecacuanha, in occasion, as asthmatical paroxysms, only to be considered as produced in particular constitutions, I must learn from the intelligent correspondence of your journal.

--on the system, by vapour from ammonia muriate of platina.

Every time I have had occasion to open a paper, or small parcel of the above precipitate, although I merely touched it with my fingers, or even when I did not touch it, but merely inspected it for a minute or two, I was in a few

few minutes affected with an uneasy sensation in my eyes, nostrils, throat and lungs, exacting a discharge of tears, sneezing, with running from the nose as in a catarrh, shortness of breath, attended by an itching and heat of the face with sometimes redness of it as from erythema. The last time I was affected, although I had not touched the precipitate, I experienced along with the above effects a slight disagreeable taste, and the dyspnœa continued after the catarrhal symptoms had vanished; which they do usually in about an hour. It may be proper just to mention also, that after leaving my laboratory for about two hours after the above effects came on, and by which time I was nearly recovered, as soon as I returned to the place where I opened the parcel, but did not again expose myself to it, the above symptoms were again brought on, although in a slight degree. I found wetting my face with cold water very serviceable in removing the erythema, and removing of course the heat.

I take for granted it is commonly known that by a similar exposure to the powder of ipecacuanha root, a fit of asthma is brought on in particular persons, although so rarely that such persons are considered to have what is called idiosyncrasy of constitution.

The diffusion through the air, manifested in the above cases of invisible and imponderable particles of matter, may serve to enable us to conceive the mode in which infectious matters are communicated.

I am,
Dear Sir,
With much regard,
An Occasional Correspondent.

Oct. 10th, 1806.

VIII.

Extract from a Letter of M. Proust, to M. Vauquelin, on Porcelain and on the Alimentary Use of Lichen Islandicus.*

Madrid, Dec. 22, 1805.

SIR,

Excellent pottery made from spuma maris.

I WAS visited by one of your pupils, M. Siquiera, an interesting and intelligent Portuguese young gentleman. We are going, to-morrow, to see the manufacture of porcelain under the direction of M. Sureda, who was brought up to this art in the manufactory of Sevres, and now makes a most beautiful porcelain, of a much harder texture than yours. This is not effected by means of kaolin, but with the *spuma maris*, a *siliceous magnesian stone*, found in the neighbourhood of Madrid; we shall send you some patterns which will astonish you. He covers his biscuit with feldspaths of Gallicia, which are very beautiful. The stone above mentioned would be excellent for the construction of chemical furnaces. When taken from the quarry, it is soft and admits of being cut like soap. Furnaces made of this stone are extremely light, and never undergo fusion, however intense the heat may be. Were such a fossil to be met with near Paris, we might do without the *rue mazarine*, (qu ?). Besides magnesia, silex, and some particles of argil and lime, this stone contains a portion of potash, which contributes, not a little, to the superior qualities of the porcelain.

Lichen Islandicus; its value as food.

The following fact is perhaps no less interesting than that above alluded to. Don Mariano la Gasca, pupil of Cavanillez, a young botanist of great promise, has just presented me with a specimen of Lichen *(Islandicus)* which he has discovered in the mountains of Leon, where it grows plentifully.

I expected to find in it merely a weaker or stronger tinctorial matter; but I find when properly boiled it is very good to eat, is very tender, and, I think ought to be considered

* Annales de Chimie, Vol. LVII. p. 196.—February 1806.

sidered a resource for food provided by Nature perhaps in every country, which has hitherto been overlooked. I would recommend you to draw the attention of the botanists at Paris towards this plant, and provide some yourself for the entertainment of your friends; it is an excellent culinary vegetable. I think I once saw some at Vincennes or in the *Bois de Boulogne*.

Particular account of the good qualities of the Lichen.

One pound of this Lichen, dry, produced three pounds when dressed and well drained: it may be eaten with oil, butter, and no doubt in many other ways. We have already had it six times on our table, and my friends were much pleased with it. Its texture is purely membranaceous, containing neither wood nor filaments, which renders it a very agreeable food. It may be reasonably expected, that in so numerous a family, other species may be found equally nourishing, and perhaps more so. Although very elastic after being dressed, it contains not the least animal matter; for its products are similar to those of sugar, which has surprised me. A pound of this Lichen will make eight pounds of soup, which in cooling, turns to jelly, like that made from animal food. It is slightly bitter, but not more so than weak chicory water. I seasoned some with sweet and bitter almonds, lemon peel, and sugar, and it made me a very nutritious and agreeable dish. The mucilage of this plant is gelatinous, very different from gum; it appears to me to resemble that obtained from fruits. I am going to examine it in other respects, and to ascertain whether this plant affords any colouring matter for dying processes. At all events it appears that Nature cannot furnish a more excellent article of food than this vegetable.

IX.

On the Means of preserving Water in long Sea Voyages, and the application of the same Means for keeping Wines. By M. L. G.*

Proposal by Berthollet to carbonize or char the inside of casks.

MR. BERTHOLLET in the year 1803 communicated to the Class of Mathematical and Physical Science of the National

* Annales de Chimie, LIX, p 96.

National Institute of France, the result of an experiment on the property of charcoal to preserve water. He had four months before that time filled with water two casks, one of which had its internal surface burned. The water it contained proved fit for use, and without any bad flavour; while that in the other cask, which had not been so prepared, was so much corrupted that the smell was intolerable.

Successfully carried into effect at Sea

The Court Gazette of Petersburgh, of May 30 last, contains an account of the success which this process was attended with in the ship of Captain Krusenstern.

He writes from Kamschatka, the 8th July 1805, to Mr. Schubert, of Petersburgh, that during his stay at Copenhagen a journal * fell into his hands, in which this process is indicated by a French chemist; that he immediately caused the internal surface of 50 or 60 casks to be burned within in a much more effectual manner than is usually done in ships of war, where the charring being only slight, the advantages are also very trifling.

by Mr. Krusenstern.

During his stay at the Brazils, Mr. Krusenstern also caused the greatest part of his casks to be burned inside; and during the whole of his passage as far as the Isle of Washington, the water in these casks was constantly found to be good. In order to maintain the cleanliness

* This journal is probably that of M. M. Pfaff and Friedlander, which was printed at Leipzic under the title of *Die neuesten entdeckungen Fransosischer gelehrten, &c.* It contains, in the Number for May 1803, an extract of the memoir of Berthollet on this subject; the author of that article thinks he recollects that Lord Macartney had before used powdered charcoal in his provision of water for his voyage to China; but this does not take away the priority of carbonizing the inner surface of the casks.—Note of the Author.

The author proceeds to express his doubts whether charcoal was really used for this purpose in that voyage, but I have thought it needless to translate his remarks, because it is certain that Lowitz, to whom the merit of the first discoveries of the active power of charcoal in purifying and otherwise changing a great number of bodies, did very early apply it to the purifying and preserving natural waters. See three volumes of Memoirs translated from Crell's Journal, and published in London in 1793, by Baldwin. The process of clarifying muddy water by a very minute addition of alum, which is mentioned in the same voyage as practised in China, has been long known, and in common use here.—N.

of

of these casks, he preferred the inconvenience of having his ballastage to attend to rather than fill them up with sea water, as is usual, when they were empty, which tends to hasten the corruption of the fresh water that may be afterwards put into them. On his arrival at Japan, he burned as strongly as possible every one of his water casks, and the success of this practice was still more evident during a passage of seven weeks from thence to Kamschatka.

"Our water," says he, "was constantly pure, and as "good as that from the best springs; so that we have "had the honor of being the first to carry so simple and "so useful a practice into effect; and the French Chemist will perhaps receive some satisfaction from hearing of our happy success."

The water at sea was as tasteless as spring water.

The preceding notice is followed by an address on the part of one of the Editors of the Annales de Chimie to Mr. *Berthollet*, in farther explanation of the subject. He remarks, that

The coating of charcoal acts in two manners; 1. It opposes the solution of the extractive part of the wood. 2. It prevents the putrefaction of that which may have been dissolved from such parts of the wood as might not have been originally well charred, or from which the coal may have been detached.

If the charcoal were merely to be put into the cask, or the putrefaction were corrected by means of filters containing charcoal powder, the first effect would not be obtained; and the second would even cease to be produced as soon as the property of the charcoal should be exhausted.

The process for carbonizing the inner surface of casks may also afford advantages for the preservation of wines.

The same process promises to be of value in casks for wine.

Wine, as well as water, must dissolve the extractive part of wood; and its taste, particularly when it has not one which predominates, must by that means be altered. This is the reason why casks which have already been much used are preferable to those which are new.

2. This extractive part probably favours the acid fermentation, which easily takes place in sea voyages in consequence of agitation and an elevated temperature. Hence it

it is that many kinds of wine cannot be conveyed by sea or to great distances.

Wine sufficiently clarified becomes perfect in bottles. Does not this arise from its being preserved from the extractive part of wood? and may we not conjecture that it would become still more agreeable if preserved in casks charred within, and which on that account might be substituted instead of stone ware, or good glass, besides possessing that large capacity which is favourable to the last fermentation, which renders its qualities perfect?

General view of the subject.

Spirituous liquors likewise dissolve the extractive part of wood, and receive qualities which are in some cases valued, but in others detrimental. The charred casks would prevent this effect. In a word, the casks which have received this preparation may be used for all the purposes in which liquids are to be preserved, without being affected by the extractive part of wood, and they prevent the putrefaction to which some of them may be subject.

These views are perhaps carried too far, and may require to be supported by experience. The observations here given may serve to direct the proceeding for this purpose, which cannot but be interesting to chemists as well as others.

X.

A Chemical Examination of the Hepatic Ore of Mercury from Idria. By M. Klaproth.

Analysis of the hepatic ore of Mercury.

THE compact hepatic Mercury employed in this analysis, is of a colour which holds a middle rank between a deep cochineal red and the grey of lead; it is almost always found in compact masses. The faces of contact are brilliant. It exhibits a very slight metallic lustre in its fracture; is opake; its powder is of a deep brown red; and the scraped part shinesa little. It is tender, not brittle, and has a specific gravity of 7, 1.

The polish it takes is bad, and in this state it appears

pears of a clear liver-coloured brown, whence it has its name.

Analysis of the hepatic ore of Mercury.

A. 1000 grains of this ore, distilled with half its weight of iron filings, afforded 818 grains of pure mercury, the residue consisted of sulphuret of iron mixed with a black powder, soiling the fingers like soot.

B. a. 100 grains reduced to fine powder were heated in 500 grains of muriatic acid to ebullition.

Sulphurated hidrogen gas was disengaged. The mineral was decomposed by adding, a little at a time, 100 grains of nitric acid; a black residue of ten grains remained. This residue was burned in a porcelain capsule very carefully, in order that the sulphur only might be burned. There remained three grains of a light coaly powder, which became ignited and burned by a stronger heat, leaving one grain of reddish ashes.

b. The solution was precipitated by the muriate of barytes. The sulphate of barytes, which was obtained after having been made red hot, weighed 46,5 grains; so that there were 6,5 grains of sulphur converted into sulphuric acid by the action of the nitric acid. Estimating the quantity of sulphur contained in the sulphurated hidrogenous gas at 0,25 grains, we have 13,75 parts of sulphur in 100 of the mineral.

C. a. 1000 grains of hepatic mercury in powder were put into a retort adapted to the pneumatic apparatus; the heat was gradually raised till the residue became red hot. After the first heat had driven out the atmospheric air, sulphurated hidrogen gas issued forth, which burned with a blue flame; its volume was 24 cubic inches, without reckoning that which had been absorbed by the water put into the intermediate receiver, which was strongly impregnated with it.

b. A few globules of mercury were collected in the receiver. In the neck of the retort was a mixture of Ethiops mineral of a greasy looking humidity, some small metallic globules, and a few small needles of cinnabar. The mercury which was mechanically extracted from this mixture weighed 3,17 grains. The posterior part of the neck of the retort was alone covered with a

 solid

Analysis of the hepatic ore of Mercury.

solid sublimate of pure cinnabar which weighed 2,56 grains.

c. The residue appeared in the form of a coaly powder resembling soot, and weighed 39 grains. When burned in the open air in a roasting test, it left 16 grains of ashes; so that the carbon consumed amounted to 23 grains.

d. The earthy residue was digested with muriatic acid. Silex remained at the bottom, which after ignition weighed 6,5 grains.

e. The muriatic solution, which was of a yellow colour inclining to light green, was supersaturated with ammonia; a brown viscid precipitate fell down, and the fluid assumed a light blue tinge. The precipitate when dissolved in an hot alkaline lixivium left the oxide of iron, which was attracted by the magnet after having been ignited, and weighed 2 grains.

f. Muriate of ammonia was poured into the alkaline fluid, and threw down alumine, which after ignition weighed $5\frac{1}{2}$ grains.

g. The other ammoniacal fluid was supersaturated with muriatic acid. A bar of zinc immersed therein separated 0,20 grains of metallic copper.

On collecting the results of this analysis of the hepatic ore of Idria we find that 1000 parts consist of

Mercury	818	
Sulphur	137	50
Charcoal	23	
Silex	6	50
Alumine	5	50
Oxyde of Copper	2	
Copper	0	20
Water which served to form the sulphurated hidrogen gas, and other loss	7	30
	1000	

This analysis may serve to rectify the false notions which have been adopted concerning the composition of this

this mixed mineral. By shewing that the sulphur is combined with the metal in the same proportion as in cinnabar, namely as 1 to 6 in round numbers, we are taught how little foundation there is for the opinion of those who, like Sage and Kirwan, think that a part only of the mercury is in the state of sulphurated mercury, and that the other is in the state of a simple oxide. If that were the case, the non-sulphurated part would certainly be soluble in the nitric acid. Experiment shews that this is not the case, because the acid cannot dissolve any part, even when boiling, the mineral powder remaining unchanged at the bottom of the vessel. This opinion has perhaps been taken up from observing that in sublimation a part only of the mineral rises in the state of cinnabar, while the other passes in the form of fluid mercury. But this arises from the presence of charcoal among its ingredients, which decomposes cinnabar at an elevated temperature: whether it be that the carbon takes from the mercury the minimum of oxygen necessary to the formation of cinnabar, or whether it be that the sulphur which combines at an high temperature with the carbon, and forms carbonated sulphur, is put into a state in which it cannot combine chemically with the mercury. The facts shew that it is really so; for having as a direct proof sublimed artificial cinnabar with lamp black, the greatest part of the cinnabar was decomposed in the same manner as the hepatic mercury, and the result was a mixture of Ethiops mineral and globules of metallic mercury.

Analysis of the hepatic ore of Mercury.

As an observation on the state in which mercury exists in cinnabar, I shall add that the antient opinion that it has the state of a perfect oxide cannot be maintained from the proofs which have been given by Proust, Bucholz, and others.

But does cinnabar absolutely contain no oxigen? and is the mercury in the metallic state? For my part, I think the question requires to be examined more exactly. From the appearances it seems that the mercury must exist in cinnabar at a very low degree of oxidation; which on that account has not yet been examined by observers. On this question, respecting which the present

sent limits do not permit me to say more, it must be observed, 1. that in cinnabar, whether natural or artificial, the metallic base, like all the other metals, at their lowest degree of oxidation, resists solution in the nitric acid; 2. that in the fabrication of cinnabar in the dry way, is always accompanied with an inflammation which appears to me to be an oxidation.

XI.

On the Quantity and Velocity of the Solar Motion. By WILLIAM HERSCHEL, *L.L. D. F. R. S.* *From the Philosophical Transactions for* 1806.

Investigation of the proper motion of the sun.

THE direction of the solar motion having been sufficiently ascertained in the first part of this paper*, we shall now resume the subject, and proceed to an inquiry about its velocity.

The proper motions, when reduced to one direction, have been called quantities, to distinguish them from the volocities required in the moving stars to produce those motions. It will be necessary to keep up the same distinction with respect to the velocity of the solar motion; for till we are better acquainted with the parallax of the earth's orbit, we can only come to a knowledge of the extent of the arch which this motion would be seen to describe in a given time, when seen from a star of the first magnitude placed at right angles to the motion. There is, however, a considerable difference between the velocity of the solar motion and that of a star; for at a given distance, when the quantity of the solar motion is known, its velocity will also be known, and every approximation towards a knowledge of the distance of a star of the first magnitude will be an approximation towards the knowledge of the real solar velocity; but with a star it will be otherwise; for though the situation of the plane in which it moves is given, the angle of the direction

* Phil. Trans. for 1805, page 231; or see our Journal, Vol. XIII. p. 59.

of

of its motion with the visual ray will still remain unknown.

Investigation of the proper motion of the sun.

As hitherto we have consulted only those proper motions which have a marked tendency to a parallactic centre, we ought now, when the question is to determine the velocity of the solar motion, to have in view the real motion of every star whose apparent motion we know; for as it would not be proper to assign a motion to the sun, either much greater or much less than any real motion which may be found to exist in some star or other, it follows that a general review of proper motions ought to be made before we can impartially fix on the solar velocity; but as trials with a number of stars would be attended with considerable inconvenience, I shall use only our former six in laying down the method that will be followed with all the rest.

Proportional Distance of the Stars.

We are now come to a point no less difficult than essential to be determined. Neither the parallactic nor real motion of a star can be ascertained till its relative distance is fixed upon. In attempting to do this it will not be satisfactory to divide the stars into a few magnitudes, and suppose *these* to represent the relative distances we require. There are not perhaps among all the stars of the heavens any two that are exactly at the same distance from us; much less can we admit that the stars which we call of the first magnitude are equally distant from the sun. And indeed, if the brightness of the stars is admitted as a criterion by which we are to arrange them, it is perfectly evident that all those of the first magnitude must differ as much in distance as they certainly do in lustre; yet imperfect as this may be, it is at present the only rule we have to go by.

The relative brightness of our six stars, may be expressed as follows: Sirius - - - Arcturus - Capella ; Lyra - - Aldebaran . Procyon.

The notations here used are those which have been explained in my first Catalogue of the relative Brightness of the Stars*; but to denominate the magnitudes of these six

* Phil. Trans. for 1796, page 189.

stars,

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stars, so that they may with some probability represent the distances at which we should place them according to their relative brightness, I must introduce a more minute subdivision than has been commonly admitted, by using fractional distinctions, and propose the following arrangement.

Table VIII.

Proportional Distances of Stars.

Sirius	1,00	Lyra	1,30
Arcturus	1,20	Aldebaran	1,40
Capella	1,25	Procyon	1,40

The interval between Sirius and Arcturus is here made very considerable; but whoever will attentively compare together the lustre of these two stars, when they are at an equal altitude, must allow that the difference in their brightness is fully sufficient to justify the above arrangement.

The order of the other four stars is partly a consequence of the distance at which Arcturus is placed, and of the comparative lustre of these stars such as it has been estimated by observations. But if it should hereafter appear that other more exact estimations ought to be substituted for them, the method I have pursued will equally stand good with such alterations. I have tried all the known, and many new ways of measuring the comparative light of the stars, and though I have not yet found one that will give a satisfactory result, it may still be possible to discover some method of mensuration preferable to the foregoing estimations, which are only the result of repeated and accurate comparisons by the eye. Whenever we are furnished with more authentic data the calculations may then be repeated with improved accuracy.

Effect of the Increase and Decrease of the Solar Motion, and Conditions to be observed in the Investigation of its Quantity.

The following table, in which the 2d, 4th, and 5th columns contain the sides of the parallactic triangle, is calculated with a view to show that an increase or decrease

of

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of the solar motion will have a contrary effect upon the required real motions of different stars; and as we are to regulate the solar velocity by these real motions, an attention to this circumstance will point out the stars which are to be selected for our purpose.

Table IX.

Stars and relative Distances.	Apparent Motion.	Solar Motion.	Parallactic Motion.	Real Motion.	Velocities.
Sirius		1,0	″ 0,67768	+ ″ 0,46518	465175
1,00	1″,11528	1,5	1,01652	+ 0,21701	217007
		2,0	1,35536	− 0,32776	327755
Arcturus		1,0	0,53579	+ 1,57389	1888670
1,20	2″,08718	1,5	0,80368	+ 1,30478	1565735
		2,0	1,07158	+ 1,01561	1218736
Capella		1,0	0,79593	− 0,42159	526987
1,25	0″,46374	1,5	1,19390	− 0,79637	995465
		2,0	1,59186	− 1,18662	1483270
Lyra		1,0	0,32542	− 0,47065	611839
1,30	0″,32435	1,5	0,48812	− 0,59923	778995
		2,0	0,65083	− 0,74135	963750
Aldebaran		1,0	0,65117	− 0,53208	744913
1,40	0″,12341	1,5	0,97676	− 0,8 737	1200324
		2,0	1,30234	− 1,1 283	1655967
Procyon		1,0	0,66394	+ 0,59548	833665
1,40	1″,23941	1,5	0,99591	+ 0,30731	430227
		2,0	1,32788	− 0,23385	327390

The real motion of Arcturus contained in the 5th column compared with that of Aldebaran, shows that when the solar motion is increased from 1,0 to 1,5 and to 2″,0 the real motion of Arcturus will be gradually diminished from 1,57 to 1,30 and to 1″,02, while that of Aldebaran undergoes a contrary change from 0,53 to 0,86 and to 1″,18. We may also notice that Capella and

Aldebaran,

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Aldebaran, which have a negative sign prefixed to their real motions when the solar motion is 1″,0 are affected differently from Arcturus, Sirius, and Procyon, which have a positive sign; and that even the motions of the two last become negative when the solar motion is increased beyond a certain point. It may be easily understood that the motion of Arcturus itself would become negative were we to increase the solar motion till the parallactic motion of this star should exceed its apparent motion.

From these considerations it appears, that a certain equallization, or approach to equality may be obtained between the motions of the stars, or between that of the sun and any one of them selected for the purpose; for instance, the motions of Arcturus and Aldebaran being contrary to each other, may be made perfectly equal by supposing the sun's annual motion to be 1″,85925. For then we shall have the real annual motion of Arcturus towards the parallactic centre 1″,091, and that of Aldebaran towards the opposite part of the heavens, in which the solar apex is placed, will be 1″,091 likewise; the first in a direction 55° 29′ 39″ south-preceding, the latter 88° 16′ 31″ north-following their respective parallels; and a composition of these motions with the parallactic ones arising from the given solar motion, will produce the apparent motions of these stars which have been established by observation. But since Arcturus, by the hypothesis which has been adopted in Table VIII. is a nearer star than Aldebaran, the velocities of the real motions, describing these equal arches will be 1309109 in the former and 1527780 in the latter. And it is not the arches but these velocities that must be equalized. Therefore, in order to have this required equality, let the solar motion be 1″,718865 then will a velocity of 1399478 in Arcturus, and 1399842 in Aldebaran, which are sufficiently equal, occasion such angular real motions in the two stars as will bring them, when compounded with their parallactic motions, to the apparent places in which we find them by observation.

Before we proceed, it will be proper to obviate a remark that may be made against this way of equalization or

or approach to equality. We have said that the calculated velocities are such as would be true if the stars were at the assumed distances, and if their real motions were performed in lines at right angles to the visual ray; to which it may here be objected that the last of these assumptions is so far from having any proof in its favour, that even the highest probability is against it. We may admit the truth of what the objection states, without apprehending that any error could arise on that account, if the solar motion were determined by this method. For if the stars do not move at right angles to the visual ray, their real velocity will exceed the calculated one; so that in the first place we should certainly have the minimum of their velocities: and if we were obliged, for want of data, to leave the other limit of the motion unascertained, it must be allowed to be a considerable point gained if we could shew what is likely to be the least velocity of the solar motion; but a more satisfactory defence of the method is, that if we were to assume a mean of all the angular deviations from the perpendicular to the visual ray that may take place in the directions of the real motions of the stars, the only position we could fix upon as a mean would be an inclination of 45 degrees. For in this case the chance of a greater or smaller deviation would be equal; and when a number of stars are taken, the deviations either way might then be supposed to compensate each other; but what is chiefly to our purpose, not only the angle of 45 degrees, but also any other, that might be fixed upon as a proper one to represent the mean quantity of sideral motions, would lead exactly to the same result of the solar velocity to be investigated. For if the velocities of any two stars were equalized, when their motions are supposed to be perpendicular to the visual ray, they would be as much so when they make any other given angle with it; and it is the equalization or approach to equality and not the quantity of the velocities that is the spirit of this method. I have only to add, that an equalization of the solar motion with that of any star selected for the purpose may be had by a direct method of calculation, and will therefore be of great use in settling the rate of the motion to be determined.

Investigation of the prope motion of the sun.

Investigation of the proper motion of the sun.

It must be evident from what has been said, that a certain mean rate, or middle rank, should be assigned to the motion of the sun, unless very sufficient reasons should induce us to depart from this condition. To obtain this end must consequently be our principal aim; and if we can at the same time bring the sidereal motions to a greater equality among each other, it will certainly be a very proper secondary consideration.

There are two ways of taking a mean of the sidereal motions, one of them may be called the rate and the other the rank. For instance, a number equal to the mean rate of the six numbers, 2, 6, 13, 15, 17, 19, would be 12; but one that should hold a middle rank between the three highest and three lowest of the six would be 14. In assigning the rate of the solar motion it appears to be most eligible that it should hold a middle rank among the sidereal velocities. We shall however find that nearly the same result will be obtained from either of the methods.

With respect to our second consideration, we may see that it also admits of a certain modification by the choice of the solar motion; for in Table IX. when this motion is 1″,5 the velocity of Arcturus 1565735, will exceed that of Sirius, 217007, more than seven times; whereas a solar motion of 1″ will give us the proportional velocities of these stars as 188867 to 465174; and the former will then exceed the latter only four times.

Calculations for drawing Figures that will represent the observed Motions of the Stars.

The necessary calculations for investigating the solar motion are of considerable extent, and may be divided into two classes, the first of which will remain unaltered whatsoever be the solar motion under examination, while the other must be adjusted to every change that may be required.

The direction of the sun remaining as it has been settled in the first part of this Paper, the permanent computation of each star will contain the annual quantity of the observed or apparent motion, its direction with the parallel of the star, its direction with the parallactic motion, and

and its velocity. The changeable part will consist of the angular quantity of the real motion, the parallactic direction of this motion, and its velocity.

Investigation of the proper motion of the sun.

Before we can make a calculation of the required velocities, we must fix upon the probable relative distance of the rest of the stars, in the same manner as we have done with the first six. In this I have thought it advisable to distinguish the stars that, from their lustre, may be called principal, and have limited their extent to the brightest of the second magnitude, on account of the uncertainty which still remains about their progressive distances. For though it appears reasonable to allow that the bright stars of the second magnitude may be twice as far from us as those of the first, it will admit of some doubt whether this rule ought to be strictly followed up to the 3d, 4th, 5th, and 6th magnitude; especially when it is not easy to ascertain the boundaries which should limit the magnitudes of very small stars.

The number of these principal stars is 24. The remaining 12 are also arranged by admitting that their magnitudes express their relative distances; and notwithstanding the doubtfulness we have noticed, their testimony with respect to the proper quantity of a solar motion, though it should be received with some diffidence, must not be neglected; some considerable alteration in their supposed distances, however, would have but little effect upon the conclusions intended to be drawn from their velocities.

The following Table contains the result of the calculations that relate to the permanent quantities. In the first and second columns, we have the names of the stars, and their assigned relative distances. The third gives the apparent angular motions, and the fourth their direction. The fifth contains the direction of the same motions, with respect to the parallactic motions arising from the given solar direction; and the sixth gives the velocity of the stars which produce the quantity of the apparent motions.

Table X.

Names of the Stars.	Proportional Distances.	Apparent Motions.	Direction with the Parallel.	Direction with the parallactic Motion.	Velocity of the Stars.
Sirius	1,00	1,″11528	68.49.40,7 *sp*	10.24.44,3 *sf*	1115281
Arcturus ...	1,20	2,08718	55.29.42,0 *sp*	0. 0. 3 *sp*	2504621
Capella.	1,25	0,46374	71.35.22,4 *sf*	24.40.21 *sf*	579668
Lyra.	1,30	0,32435	56.20.57,3 *nf*	92.49.30 *nf*	421657
Rigel	1,35	0,16273	79.29.33,9 *np*	159.28. 1 *np*	219684
αOrionis....	1,35	0,13038	85.38.14,6 *nf*	169.18.58 *np*	176010
Procyon....	1,40	1,23941	50. 2.24,5 *sp*	9.40.46 *sp*	1735172
Aldebaran ..	1,40	0,12341	76.29.37,3 *sf*	13.41.48 *sf*	172778
Pollux	1,42	0,65037	0. 0. 0 *prec.*	61.30.34 *sp*	923523
Spica.	1,44	0,19102	84. 5. 1,8 *np*	144.13.16 *np*	275065
Antares	1,46	0,26000	90. 0. 0 *north*	178.57.44 *np*	379600
Altair	1,47	0,71912	48.40.12,0 *nf*	103.17.29 *nf*	1057105
Regulus	1,48	0,22886	20.27.37,5 *np*	70. 9.20 *sp*	338711
βLeonis	1,50	0,55324	7.16. 8,4 *sp*	40.34.31 *sp*	829856
βTauri.	1,50	0,10039	84.58.27,1 *sf*	13.17.11 *sf*	150579
Fomalhaut..	1,50	0,30698	11.16.16,3 *nf*	16.47. 5 *sf*	460469
αCygni.	1,60	0,06440	27.45.56,3 *np*	177.31.39 *np*	103036
Castor	2,00	0,13294	17.30.40,6 *sp*	45.25.43 *sp*	265869
αOphiuchi ..	2,00	0,07698	40.30.24,8 *sf*	33.29.28 *sf*	153955
αCoronæ ...	2,00	0,23279	7.24.15,4 *sf*	105. 0.43 *nf*	465587
αAquarii ...	2,00	0,20615	67.10.17,1 *np*	162.43.46 *nf*	412295
αAndromedæ	2,00	0,09268	40.20.48,2 *sf*	12.55.11 *sf*	185360
αSerpentis ..	2,00	0,21913	60. 7.12,5 *nf*	161.34. 4 *nf*	438257
αPegasi	2,00	0,18917	72. 5.16,0 *np*	157.45.25 *nf*	378338
αHydræ	2,30	0,16598	57.30.24,8 *np*	107. 6.24 *np*	381763
α^2 Libræ	2,40	0,18376	54.42.52,9 *np*	127. 3. 7 *np*	441022
γPegasi.	2,50	0,17355	59.48. 7,9 *np*	174. 5.15 *nf*	433880
αArietis	2,50	0,11587	37. 9.15,9 *sf*	29.32.47 *sf*	289685
αCeti	2,80	0,14406	33.44. 2,9 *np*	141.18.55 *np*	403356
αHerculis. ..	3,00	0,23000	90. 0. 0 *north*	168.23.41 *nf*	690000
βVirginis ..	3,00	0,77706	17.59.25,5 *sf*	111.11.44 *nf*	2331169
γAquilæ....	3,00	0,19320	55.54.41,7 *np*	178.25.20 *nf*	579589
α^2 Capricorni	3,50	0,26452	79.23.35,3 *nf*	136.21.18 *nf*	925819
βAquilæ....	4,00	0,35127	85. 7.37,0 *sp*	39.49.15 *sp*	1405079
ά Capricorni	4,20	0,28000	90. 0. 0 *north*	146.59.44 *nf*	1176000
ά Libræ	6,00	0,20898	59.27.58,4 *np*	131.46. 7 *np*	1253875

The contents of this Table will enable us to examine the motions of the stars in different points of view. For instance, by the apparent motions in the third column, and their directions in the fourth, a figure may be drawn which will represent the actual state of the heavens, with respect to those annual changes in the situations of our 36 stars, which in astronomical tables are called their proper motions.

Investigation of the proper motion of the sun.

Fig. 1, Plate VI. gives us these motions brought into one view, so that by supposing successively every one of the stars to be represented by the central point of the figure, we may see the angular quantity and direction of the several annual proper motions represented by the line which is drawn from the centre to each star. By this means we have the comparative arrangement and quantity of these movements with respect to their directions.

Fig. 3 represents the same motions, but instead of being drawn so as to show their directions with regard to the several meridians and parallels of the stars, they are laid down by the angles contained in the fifth column; and will therefore indicate their arrangement with respect to a line drawn from the solar apex toward the parallactic centre. These directions will remain the same, whatever may be the velocity of the solar motion upon which we shall ultimately fix, provided no change be made in the situation of the apex toward which the sun has been admitted to move.

In these two figures, the lines drawn from the centre give us only the angular changes of the places that have been either observed or calculated, and not the velocities which are required in the stars to produce them. It will therefore be necessary to represent the velocities by two other figures, in which the same directions are preserved, but where the extent of each line is made proportional to the distance of the stars in the second column.

Fig. 2 is drawn according to this plan; the angles of the directions remain as in the fourth column, but the lines are lengthened so as to give us the velocities contained in the sixth.

In Fig. 4, the angles of the 3d figure are preserved, but the lines are again lengthened as in Fig. 2.

N. B. These

N. B. These two last figures would have been of an inconvenient size if they had been drawn on the same scale with the two foregoing ones, for which reason, in comparing the 2d and 4th with the 1st and 3d, it must be remembered that the former are reduced to one half of the dimensions of the latter.

[The Conclusion in our next.]

XII.

Discovery of a New Vegetable Principle in Asparagus. (Asparagus Sativus. Linn.). By Messrs. VAUQUELIN *and* ROBIQUET*.

New vegetable principle in asparagus.

BY examining more attentively than was formerly done the products of vegetation, modern chemists have distinguished a great number of substances unknown to the antients; but it is a long time, I apprehend, since any immediate principle has been discovered which is so singular and interesting as that of which we are about to speak.

During the last summer, Mr. Robiquet, a young chemist, who unites solidity of reasoning to a great skill in experiments, subjected upon the invitation of Mr. Parmentier, the juice of asparagus to chemical analysis, of which the interesting results are to be found in our Annals.

Two kinds of crystals formed in the juice of asparagus.

Having set aside in my laboratory, during a journey which he made, a certain quantity of the juice of asparagus, concentrated by evaporation, I observed a considerable number of crystals, among which two appeared to me to belong to new substances; and as their form, transparency and taste were different, it was easy for me to separate them.

Description of one kind

One of these kinds was perfectly white and transparent after having been several times crystallized.—Its taste is cool and slightly nauseous, so as to occasion a

* Annales de Chimie, Jan. 1806.

secretion

secretion of the saliva ; it is hard, brittle, and of a regular form.

The other kind which is also white, is not so transparent nor hard, neither has it the same form ; on the contrary, it has little consistence, is crystallized in the shape of fine needles, and its taste is perceptibly saccharine, resembling that of manna. and of the other.

Mr. Robiquet in making the analysis we have alluded to, had noticed the first of these substances, but he took it for an ammoniacal salt, because in the very small quantity of imperfectly purified crystals he could then obtain, it retained between its plates. According to all appearance, some traces of salt with base of ammonia, with which the juice of asparagus abounds, and which misled him. Since that time we have in conjunction submitted this substance to new experiments, the principal of which follow. The form which it effects in its crystallization, according to M. Hauy, to whom we sent a certain quantity, is derived from a right rhomboidal prism, of which the great angle of the base is about 130 degrees. The borders of this base, and the two angles, situated at the extremity of its greater diagonal, are replaced by facets. Figure of the first kind of crystals.

This substance is moderately soluble in water, and its solution gives no signs of acid or alcali. The infusion of nut galls, the acetate of lead, the oxalate of ammonia, the muriate of barytes, and the hydro-sulphuret of potash, produced no change in its solution. Alcohol does not dissolve it. They are soluble in water, and neither acid nor alkaline.

As these experiments indicate that the substance in question is not a salt with an earthy base, we triturated a certain quantity with caustic potash and a little water, in order to see whether ammonia would be disengaged ; but no traces were exhibited. The potash appeared to us to render it more soluble in water. They are not earthy nor ammoniacal.

As we saw that it contained neither earth nor ammonia, we directed our enquiries to ascertain the existence of the alcalis, and for that purpose we burned a somewhat considerable quantity in a crucible of platina. At first it swelled up and emitted penetrating vapours which affected the eyes and the nose like the smoke of wood. It afforded a large portion of charcoal, which had no taste and —nor neutral.

left

left nothing after its incineration but an almost imperceptible trace of earth, which no doubt was casually present.

Towards the end of the decomposition of this substance, the odour which was disengaged was somewhat similar to that of animal matter, and likewise inclining to that of ammonia.

Action of nitric acid.

The nitric acid decomposes this substance, nitrous gas being disengaged while the fluid assumes a yellow colour and a bitter taste, like animal substances. When the action of the nitric acid is completed, lime disengages abundance of ammonia from the liquid.

This alkali is therefore formed in the operation we have described, since the substance from asparagus did not afford perceptible signs before.

General conclusions.

This substance is not an acid since it does not redden the tincture of tarnsole, and has not the taste which all these substances have in a more or less eminent degree.

It is not a neutral salt because it contains neither earth nor alkali; but as it affords by means of fire the same products as vegetables, we are obliged to consider it as an immediate principle of asparagus.

It is probable that like them it is composed of hidrogen oxigen, and carbon, in particular proportions; it is no less probable that it has likewise a small quantity of azote; this at least seems to be indicated by the smell, which is disengaged by heat, and the ammonia which it forms with the nitric acid.

The authors intend to pursue their experiments.

Though we have obtained a considerable quantity of this substance, we have not been able to submit it to a greater number of experiments, because most part of it was scattered in our laboratory, and there only remained the little portion which we gave to Mr. Hauy to determine its form. We have nevertheless thought it proper to communicate these facts to the Institute, in order to fix the date of its discovery, and it is our intention to proceed in our examination on the return of the asparagus season. We shall also endeavour to ascertain whether this singular matter do not exist in other vegetables.

The second kind of crystals was probably manna.

With regard to the saccharine matter which we also found in the juice of asparagus, we had not a sufficient quantity

quantity to ascertain what species of sugar it might most nearly resemble; we take it to be manna.

Conclusion.

We may therefore consider it as decided that besides the principles discovered in the juice of asparagus by Mr. Robiquet, there exists in it a principle which is crystallizable like the salts, but is neither acid nor neutral, and of which the solution in water is not affected by any of the reagents usually employed to ascertain the presence and nature of the salts dissolved in water; and also another principle which appears to resemble manna.

XIII.

A Chemical Examination of Native Cinnabar. By M. Klaproth.

I. *The Cinnabar of Japan.*

External characters of the cinnabar of Japan.

THE cinnabar of Japan is brought to Europe in the form of single grains, more or less large and crystalline. Its colour is of a deep cochineal red, approaching the grey colour of steel in the places which are not damaged; in others it is of a scarlet red, inclining to a brick-dust colour. The grains are fragments of flattened hexahedral prisms; externally smooth and of a metallic lustre; internally very bright and of a semi-metallic lustre. Their fracture crosswise is conchoidal, but longitudinally, it is obscurely lamellated. This mineral is tender, its scrapings of a scarlet red, and its specific gravity=7.710. Its fragments sometimes include specks of pyrites, and in other instances they adhere to a quartzose gangue. In order to distribute these heterogeneous parts uniformly through the mass of grains subjected to analysis, they were mixed and pounded together.

Impurities separated from the cinnabar by heat.

A. One thousand grains of this powder were sublimed in a small glass retort with a receiver adapted thereto, and filled with water. The water of the receiver acquired a turbid yellowish appearance from the particles of sulphur, which were volatilized. It had a faint smell of sulphurated hidrogen, and a slight taste of sulphureous acid. The matter remaining in the retort weighed 38 grains. It was

digested with muriatic acid; the iron from the pyritous particles was dissolved and the quartzose gangue remained.

Solution of the metallic part.

B. One hundred and four grains of the mineral, which from the preceding experiment contained 100 grains of pure cinnabar, were reduced to an extremely fine powder, and put into 500 grains of muriatic acid (sp. grav. 1,125) and heated: sulphurated hidrogen gas was disengaged. Into the solution was poured drop by drop, 100 grains of nitric acid (sp. grav. 1,235). Every time the acid was added, there was an immediate effervescence. In this manner the process was carried on till the decomposition of the cinnabar, and the complete solution of the metallic parts were effected.

Combustion of the sulphur.

b. The sulphur that remained was of a greyish yellow colour and in some degree viscid: it weighed 11,8 grains. It was burned in a roasting test and left a blackish residue of 1,5 grains, so that the contents of pure sulphur were 10,3.

c. The lively action of the nitric acid upon cinnabar, gives reason to believe that part of the sulphur was converted into sulphuric acid, by the oxigen of the decomposed nitric acid.

Deduction of the quantity of sulphur which had been acidified, and thence the proportion of mercury and sulphur in the cinnabar.

In order to ascertain the quantity of sulphur which had undergone this change, the solution of the metallic part of the cinnabar (which was of a yellow colour, on account of iron) was taken and decomposed by means of a solution of muriate of barytes. The sulphate of barytes which fell down, after having been ignited, weighed 30 grains; which answers to 4,2 grains of sulphur. A small quantity likewise escaped which has contributed to the formation of sulphurated hidrogen gas; but as this quantity did not exceed one fourth of a grain, we may conclude that 100 parts of pure cinnabar contain 14,75 of sulphur.

Analysis in the dry way afforded the same result.

C. 1040 grains of the mineral, containing, according to the essay A, 1000 grains of pure cinnabar, were mixed with half their weight of iron filings, and distilled in a suitable apparatus: the mercury thus obtained, being carefully collected weighed 845 grains.

From

From these essays we may conclude that 100 parts of Japan cinnabar, exclusive of its foreign parts, contain

Mercury . . .	84,50
Sulphur . . .	14,75
	99,25

II. *Cinnabar of Neumaerktel in Carniola.*

External characters of the cinnabar of Carniola.

Among the cinnabar mines of Europe, that of *Terhitz* on the mountain of *Loibl* near Neumaerktel, in Carniola, is particularly distinguished by the beauty of the specimen it affords.

The colour of this mineral is of a lively cochineal red. It is found in masses of considerable size, in a compact calcareous stone, of a blackish grey, and crossed by veins of white calcareous spar. The faces of contact of the ore against its gangue are brilliant, with a metallic aspect; the cross fracture is of little brilliancy, of a shining greasy aspect. It is obscurely luminated and irregular in other directions. The fragments are of an indeterminate form with obtuse edges. The masses are composed of thin separate laminæ, striated on the faces of separation. This mineral is translucid; its scrapings or powder of a very lively scarlet; it is very tender, and weighs 8,16.

Analysis as before in the dry way.

A. 100 grains of this cinnabar were reduced to very fine powder, and then boiled in 500 grains of muriatic acid. Sulphurated hidrogen gas was separated, and 100 grains of nitric acid was gradually added. The metallic part having been entirely dissolved, there remained 10,20 grains of sulphur of a clear yellow, which being burned on a test, left no residue. The muriate of barytes precipitated 27 grains of sulphate of barytes, containing 3,80 grains of sulphur. Admitting three fourths of a grain of this substance to have existed in the sulphurated hidrogen gas, it will follow that 1425 parts of sulphur were contained in 100 of the cinnabar.

The same by heat.

B. Five hundred grains of cinnabar were distilled with half its weight of iron filings. The mercury obtained from this operation, carefully collected, weighed 425

 grains,

grains, whence it follows that 100 parts of cinnabar, contain by analysis

Mercury	. .	85,0
Sulphur	. .	14,25
		99,25

XIV.

Notice of some Experiments made by the Galvanic Society at Paris.*

Pile without any moisture. I. M. MARECHAUX, of Wesel, correspondent of the Galvanic Society, announced to them that he had determined that water, whether pure or mixed with an acid, or charged with any salt, is not indispensably required for producing the effects of galvanism. He added, that some time ago he had constructed columns of zinc and brass with the interposition of discs of card, *not moistened*, which were very useful. The Galvanic Society was of course desirous of verifying a fact of this nature, and determined to repeat the experiments of M. Marechaux, as described in his letter.

—verified by experiment. Discs of zinc, which had been before used, were cleaned and restored to their usual polish. Similar pieces were made out of new *brass*. A vertical column of 49 pieces of discs was formed by the interposition of pieces of card, *not moistened*, standing upon a plate of brass, of greater dimensions, having three holes near its edges, through which, cords of silk were passed in order to support the whole apparatus. These cords were tied together at top, and the whole column suspended by them. This pile **It was weak.** which M. Marechaux distinguishes by the name of *Colonne pendule*, was put into communication with the electric micrometer of M. Marechaux, simplified by M. Veau de Launay† and it manifested an intensity of 360 degrees‡, which

* Annales de Chimie, Jan. 1806.

† See Journ. de Phys. Messidor, an. XIV.—See also our Journal, XIV. p. 350.—N.

‡ By intensity we denote the measure of the distance, at which a leaf

which was ascertained to be the effect of galvanic action, and not from the electricity of the atmosphere.

This first experiment was repeated and varied in different ways. Blotting paper was substituted instead of the pieces of card to the number of four for each, and there was no effect produced. Discs of card, dried in the oven were used, and the mean term of attraction in several experiments was 372 degrees. With the same pieces and twenty-five pair of discs only, the attraction was 160. The experiment was afterwards made with a column, having the same number of pairs of metallic discs but without the interposition of any pieces of card. In these circumstances no effect was produced. The same repeated.

These first results would have been sufficient for the Society to confirm the fact announced by M. Marechaux, and which was intended to be verified; but this galvanic action of the pendulous column was not proved, but by the help of an instrument of very great sensibility, and with regard to quantities scarcely to be estimated. It remains therefore for the Society to ascertain the advantage which it is possible to derive for the progress of galvanism, by means of a discovery so important, by employing more powerful modes of action, and by comparing them with the effects obtained from piles excited by humidity or by saline solutions. The class of the Society which is employed on physical researches, has been charged to direct its investigations. Question how far they may prove useful.

II. A notice appeared in the Moniteur of the 22nd of Brumaire last, that Dr. Joseph Baronio of Milan, had published a description of a galvanic pile, formed of vegetable matters only, with an invitation to philosophers to repeat and vary his experiments, flattering himself that they would serve to extend the application of the theory of galvanism to the whole of vegetable life. The Galvanic Society was called upon to answer this observation of Dr. Baronio*. Pile of vegetable matter only.

a leaf of gold, suspended to a vertical stem of brass, is attracted towards another stem of the same metal, terminating in a ball, when these two stems are in communication with the two poles of the pile. Each degree of this measure answers to the eighteen thousandth of an inch.

* Annales de Chimie, Jan. 1806.

A pile

The experiment repeated.

A pile was accordingly formed by them in his manner: sixty equal discs of walnut-tree were made, two inches in diameter, having a raised edge of one eighth of an inch high. These pieces were boiled in vinegar and with these and round pieces of raw beet root and of a thick raddish, (raphanus sativus of Linnæus,) a pile was constructed of sixty couple of pieces of beet root and raddish, separated by discs of wood, on the upper extremity of each of which was poured by means of the border, a solution of the acidulous tartrite of potash in vinegar. Lastly, at the lower extremity of the pile was placed a leaf of cochlearia, and at the upper extremity a double-band of blotting paper, steeped in vinegar. Every thing being thus disposed agreeably to the full description inserted in the Moniteur; frogs properly prepared for the action of this pile, were placed with the leaf of cochlearia in contact with their spinal marrow, and the band of paper with their muscles. Three frogs being thus successively and repeatedly presented, shewed not the least motion, though they were sufficiently sensible to be strongly agitated when being supported on a knife to bring them near the conductor of the pile, they were in contact with the blade or silver mounting of the handle. After having made every probable experiment with these frogs without success, the pile was brought into communication with the electomicrometer, upon which also it produced no effect. The same instrument was then presented to a pendulous pile, constructed after the manner of M. Marechaux, composed of 60 pair of new discs of copper and of zinc, with the interposition of pieces of card, not moistened. The intensity was about 180 degrees. At the same moment the frogs which had been presented to the vegetable pile were put into communication with this last, and they gave no indication of sensibility.

It did not succeed.

The electromicrometer more delicate than frogs.

The Galvanic Society did not therefore obtain in the experiments indicated by Dr. Baronio, the results which he announced; but they have served to show that the electro-micrometer made use of, is still more sensible than frogs, to shew the smallest effects of galvanism.

XV.

Observations on the Congelation of Water. By M. DISPAN, *Professor of Chemistry at Toulouse.*

ABOUT the close of the winter of the year XI. we had at Toulouse, after several days of a temperature remarkably mild, a return of cold very sudden and strong; the canal was frozen in one or two nights, and there was skating, a spectacle very uncommon in this country. The ice remained for eight hours without thawing; but notwithstanding this, the water under the bridges was never frozen, not even slightly. This singularity was noticed with surprize by every one, and I was for a long time at a loss to discover the cause. I think I now understand it.

Remarkable fact of congelation in standing water, which did not freeze under a bridge.

The earliest and the latter frosts are called white frosts, and their cause is well understood. The white appearance is formed by the dew, which crystallizes as it falls. The hard frosts in the depth of winter are, on the contrary, called black frosts, and this expression is equally applicable to the appearance of the ground in that circumstance. For this effect it is requisite that the cold should have previously deprived the atmosphere of the moisture it contained. Nothing is precipitated; but the water upon the ground or soaked into it becomes solid.

Explanation. Black and white frosts.

In fact, when a cold night suddenly follows a succession of warm days, as happens at Toulouse at the times I mention, an abundant hoar frost succeeds. The still waters receive such a quantity, that their caloric, already in part absorbed at the surface by the coldness of the air, can no longer keep up the fluid state. The hoar frost, or precipitated ice, then forms a pellicle at the surface of the water, and by its contact determines the congelation from one part to the other to a certain thickness.

Their cause.

This is not the case with running waters. These by their continual motion prevent the hoar frost from forming a coating to the surface. The frozen particles as they fall from the atmosphere are immersed and mixed with the stream; and when the coldness of the atmosphere itself

Manner in which running water congeals.

itself determines the crystallization, the same thing happens with regard to the spicular crystals thus beginning to be formed. This is the reason why rivers always begin to freeze near their marshy sides, and at places where the current is the least rapid.

— And standing water, which explains the phenomena.

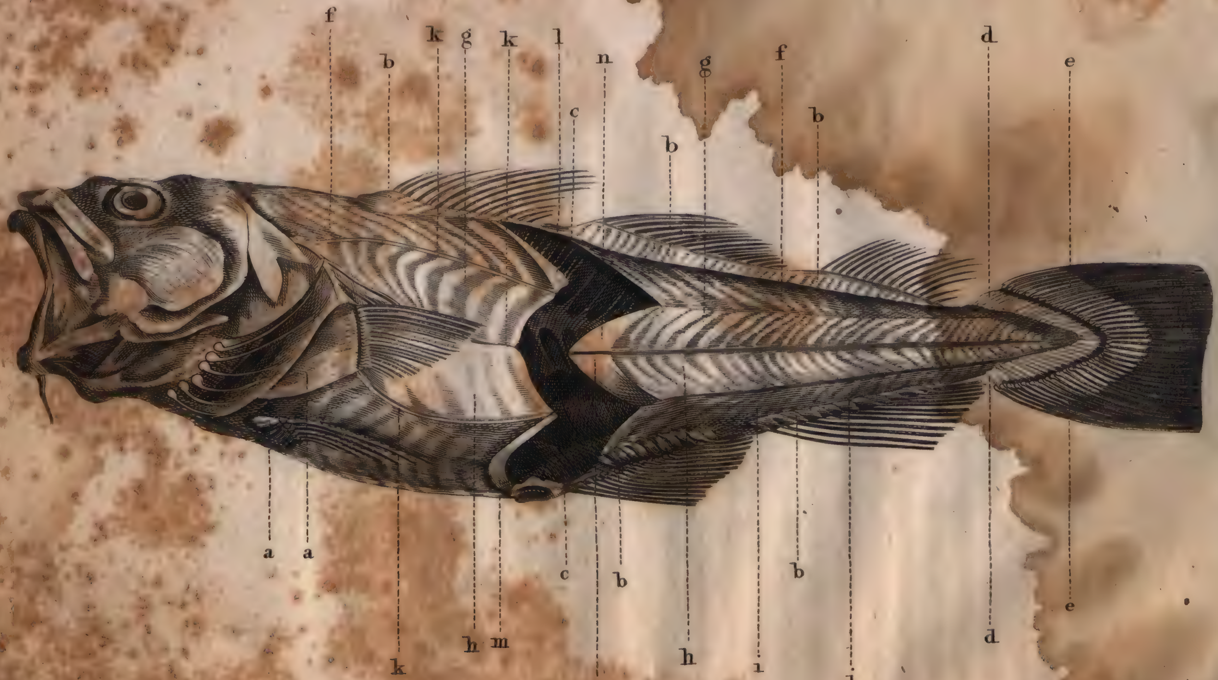
But to return to the stagnant waters. However abundant may be the deposition of hoar frost, the water beneath a bridge will receive no part of it. The surface of the water has therefore this cause of refrigeration less than at the other parts. Its caloric is not taken away but by the mere contact of the air. This condition would be sufficient to render its congelation much more slow; but its fluidity is not less preserved by its surface being defended from the predominating action of the hoar frost, which would follow if that obstacle were not interposed.

Other facts of the same kind.

These facts enabled me to explain certain experiments urged by a philosophical gentleman at Paris a few years ago, to support his opinion on the existence of a material principle under the name of *frigoric*. The author of these experiments assured me, that in a frosty night the *frigoric* fell perpendicularly from the atmosphere upon the surface of the earth; and he offered the following proof. If plates filled with water be exposed to the open air at night, and it be cold enough, the water will freeze; but if one of these vessels be covered with a pane of glass, or any other body, that water will not freeze, even though the covering body do not rest immediately upon the plate. It is sufficient, continued the author, that the fall of the *frigoric* be interrupted, no matter whether from an higher or lower distance; and to complete his demonstration, he added the following experiment, which at first aspect seems very cogent, and is certainly very interesting. It is as follows: place in the evening, at a certain distance above a plate filled with water, a funnel, of which the diameter shall be less than that of the plate, you will find the next day a ring of ice formed round the circumference; but all the water situated perpendicularly beneath the funnel will remain fluid.

Explanation.

I have not repeated this last experiment; but every thing leads me to conclude that it would succeed in favorable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able circumstances; that is to say, when the air holding a certain quantity of water in solution, shall be forced to deposit it all at once in the solid form. We see consequently that in this case, without having recourse to the existence of a frigorific principle, the hoar frost falling on the sides of the funnel will be guided toward the edges of the plate, where a ring of ice will be formed before the middle shall become congealed.

XVI.

Practical Rules for reducing the apparent Distance of the Moon from the Sun or a fixed Star to the true Distance, for the Purpose of ascertaining the Longitude of the Place of Observation. By a Correspondent.

Origin of the Investigation.

AT some former periods of my life I was not unfrequently in the habit of amusing myself with practical astronomy, and, amongst other departments of it, with what are usually called the common lunar observations. In the course of these it was impossible to avoid remarking that none of the rules given at the end of the "Requisite Tables" for reducing the apparent to the true distances are by any means so short, or so easy to be remembered, as might be wished; and that it would be highly desirable to diminish the labour of this process. I was, indeed, previous to the investigation of the methods hereafter described, usually accustomed to prefer the direct solution of the two triangles, in the former of which the apparent co-altitudes and observed distance are given, and the vertical angle required, and in the other of which the true co-altitudes and azimuthal angle are given, and the base or true distance required. The following methods of performing this reduction, which I then hit upon, appearing however to me to be somewhat more eligible than any others which I have seen, I shall venture to communicate them to the public through the medium of the Philosophical Journal. They are all founded on the two following well-known analogies, viz. That the rectangle of the sines of the sides containing the vertical angle

Former rules prolix and burthensome to the memory.

Analogies on which the following rules are founded.

angle : the square of radius : : the rectangle of the sines of the differences between the half-sum of the three sides, and each of those first-mentioned sides : the square of the sine of half the contained angle; and : : the difference between the versed sines, (or the sum or difference of the co-sines,) of the base and of the difference of the sides : the versed sine, (or sum or difference of radius and co-sine,) of the same angle.

RULE I*.

First rule.

1. If the apparent distance be greater than 90°, take the sum, otherwise take the difference, of its natural co-sine and the natural co-sine of the difference of the apparent altitudes, and call it A.

2. Add together the arithmetical complements of the logarithmic co-sines of the observed altitudes, the logarithmic co-sines of the true altitudes, and the logarithm of A; reject 20 from the index, and find the correspondent natural number, which call B.

3. The difference between this number and the natural co-sine of the difference of the true altitudes is the natural co-sine of the observed distance, which will be greater or less than 90° accordingly as B is greater or less than the last-mentioned co-sine.

RULE II.

Second rule, without the use of natural numbers.

1. Add together the two apparent co-altitudes and the apparent distance, and take the difference between their half-sum and each of the apparent co-altitudes separately.

2. Add together the arithmetical complements of the logarithmic co-sines of the two apparent altitudes, the logarithmic sines of the two before-mentioned differences, and the logarithmic co-sines of the true altitudes, and halve the sum.

* Since writing the above I find that there is a method perfectly analogous to this in Mr. Thos. Keith's Trigonometry, published in , and differing only in his using secants in one part of the process instead of co-sines. As I think it, however, a very useful mode of reduction, I have not struck it out, but shall content myself with thus resigning to that gentleman the merit of the first publication of it. Q.

3. Subtract

3. Subtract from this half-sum the logarithmic sine of half the difference of the true altitudes, and the remainder will be a logarithmic tangent.

4. Find the correspondent logarithmic sine, subtract it from the before-mentioned half-sum, and the remainder will be the logarithmic sine of half the true distance.

RULE III.

Third rule, also without the use of natural numbers.

1. Add together the arithmetical complement of the logarithmic sine of half the apparent distance and the logarithmic sine of half the difference of the apparent altitudes, and their sum will be the logarithmic co-sine of an arc, which call A.

2. Add together half the sum of the logarithmic co-sines of the true altitudes, the logarithmic sine of half the difference of the apparent altitudes, and the logarithmic tangent of A.

3. Add together also half the sum of the logarithmic co-sines of the apparent altitudes and the logarithmic sine of half the difference of the true altitudes.

4. The difference between these sums is a logarithmic tangent of an arc, which call B.

5. To the logarithmic sine of half the difference of the true altitudes add the arithmetical complement of the logarithmic co-sine of B, and their sum will be the logarithmic sine of half the true distance.

RULE IV.

Fourth rule, analogous to the last.

1. Add together the arithmetical complement of the logarithmic sine of half the apparent distance and the logarithmic sine of half the difference of the apparent altitudes, and their sum will be the logarithmic co-sine of an arc, which call A.

2. Find the logarithmic sine of A; subtract from it the before-mentioned arithmetical complement, and double the remainder.

3. Add to this doubled remainder the arithmetical complements of the logarithmic co-sines of the apparent altitudes, and the logarithmic co-sines of the true altitudes, and halve the sum.

4. From this half-sum subtract the logarithmic sine of

 half

half the difference of the true altitudes, and the remainder will be a logarithmic tangent.

5. Find the correspondent logarithmic sine; subtract it from the before-mentioned half-sum, and the remainder will be the logarithmic sine of half the true distance.

We will work one of the cases given in the "Requisite Tables" by each of these rules.

Example.

Example;— Let the apparent distance of the moon from a star be 89°. 58′. 6″. the apparent altitude of the star 5°. 6′. that of the moon 84°. 46′. and her horizontal parallax 61′. 18″.; what is their true distance?

In this case the correction for the moon's parallax and refraction taken from Tab. VIII. Requisite Tables, is + 5′. 30″.; and that for the star's refraction from Table I.—9′. 44″.; so that their true altitudes are 84°. 51′. 30″. and 4°. 56′. 16″.

Then, by the First Rule.

—worked by the first rule;

Nat. cos. 79°. 40′.	.1793746
Nat. cos. 89°. 58′. 6″	.0005527
A. =	.1788219
Ar. comp. log. cos. 84°. 46′.	1.0399483
5°. 6′.	0.0017228
Log. cos. 84°. 51′. 30″.	8.9523977
4°. 56′. 16″.	9.9983855
Log. A.	$\bar{1}$.2524208
Log. B.	$\bar{1}$.2448751
Nat. cos. 79°. 55′. 14″.	.1750135
B. nat.	.1757418
Diff.	.0007283

= nat. cos. 90°. 2′. 30″. 3. the true distance.

Or, by the Second Rule. — by the second rule;

As. comp. log. cos. 84°. 46′.	1.0399483
5°. 6′.	0.0017228
Log. sin. 5°. 9′. 3″.	8.9531696
84°. 49′. 3″.	9.9982210
Log. cos. 84°. 51′. 30″.	8.9523977
4°. 56′. 16″.	9.9983852
	2)38.9438446
	19.4719223
Log. sin. 39°. 57′. 37″.	9.8077084
Log. tan. (24°. 46′ +)	9.6642139
Correspondent log. sine	9.6222792
Which subtracted from above half-sum, gives	9.8496431

= log. sine 45°. 1′. 15″. 15. half the true distance.

Or, by the Third Rule. — by the third rule;

As. comp. log. sin. 44°. 59′. 3″. ..	0.1506351
Log. sine 39°. 50′.	9.8065575
Log. cos. A. (= 25°. 1′. +)	9.9571926
Log. cos. 84°. 51′. 30″.	8.9523977
4°. 56′. 16″.	9.9983852
	2)18.9507829
	9.4753914
Log. sin. 39°. 50′.	9.8065575
Log. tan. A.	9.6691375
1st Sum.	28.9510864

Log. cos. 84°. 46′.	8.9600517
5°. 6′.	9.9982772
	2)18.9583289
	9.4791644
Log. sin. 39°. 57′. 37″............	9.8077084
2d Sum	19.2868728
Diff. sums = log. tan. B. (=24°. 46′. +)	9.6642136
As. comp. correspond. log. cos. ..	0.0419345
Log. sin. 39°. 57′. 37″............	9.8077084
Sum=log. sin. 45°. 1′. 15″. 15 as before	9.8496429

Or, by the Fourth Rule.

—by the fourth rule.

As. comp. log. sin. 44°. 59′. 3″....	0.1506351
Log. sin. 39°. 50′.	9.8065575
Log. cos. A. (= 25°. 1′. +)....	9.9571926
Log. sin. A.	9.6263301
Diff. bet. it and the above as comp.	9.4756950
	2
	18.9513900
Ar. comp. log. cos. 84°. 46′.	1.0399483
5°. 6′.	0.0017228
Log. cos. 84°. 51′. 30″.	8.9523977
4°. 56′. 16″.	9.9983852
	2)38.9438440
Half-sum....	19.4719220
Log. sin. 39°. 57′. 37″............	9.8077084

Log. tan. (24°. 46′. +)	9.6642136
Correspondent log. sine, which subtract from above half-sum	9.6222790
Diff.=log. sin. 45°. 1′. 15″. 15. half the true distance, as before	9.8496430

The advantages of the preceding modes of reduction are, that they are not difficult in practice, that they are perfectly correct, that they may be applied without using any but the common tables, that they are not incumbered with any complex distinction of cases, and that their results are void of ambiguity.

Advantages of these rules.

16*th Dec.* 1805. Q.

SCIENTIFIC NEWS.

National Institute of France.

National Institute of France, July 7, 1806.

The Class of Mathematical and Physical Sciences of the National Institute of France held its public session on the 7th of July last. The order of the readings was as follows:

1. The mathematical prize proposed for the month of January 1809 was announced.

2. A notice of the proceedings of the Class, from the 1st Messidor in the year XIII. to the 1st July 1806, philosophical department, was read by M. Cuvier, the perpetual secretary.

2. A like notice of the mathematical part of the Class during the same interval was read by M. Delambre, perpetual secretary.

4. A memoir on the affinities of bodies for light, by M. Biot.

5. A memoir on the adhesion of the particles of water to each other. By the Count of Rumford, foreign associate.

6. Historical Eulogium on M. Cells. By C. Cuvier.

The

The subject of the mathematical prize, and the prospective remarks upon the same, were as follow:

Prize question. *It is required to establish a theory of the perturbations of the planet Pallas, discovered by Mr. Olbers.*

On the computations for determining the respective places of the last discovered planets.

Geometers have given the theory of perturbations sufficiently extensive and accurate for all the planets formerly known, and for all those which might be discovered, provided they were confined to the same zodiac and had little eccentricity.

Mercury until our time was the most eccentric of all the planets, and at the same time that which had the greatest inclination; but its small mass, and its situation at one of the limits of the planetary system, render it of little effect to produce any sensible alterations in the motions of the other planets; Uranus, discovered twenty-five years ago by Dr. Herschell, is placed at the other limit of the system. With a small mass and moderate eccentricity it has also the smallest of all the known inclinations; so that the formulas which had served for Jupiter and Saturn have been more than sufficient for this modern planet.

Ceres, discovered five years ago by Mr. Piazzi, having with a considerable eccentricity an inclination 10° 38′, must be subject to great and numerous inequalities. It appears, nevertheless, that all the astronomers who have laboured to determine them have been content with the known formulas, of which the developement does not exceed the products of three dimensions of the eccentricities and inclinations. Those of five dimensions have been used in the Mécanique Céleste according to a formula of Mr. Burckhardt. The same astronomer has since presented the general and complete developement of the third, fourth, and fifth orders; but this degree of precision is not sufficient for Pallas, of which the eccentricity is greater than even that of Mercury, and the inclination 34° 38′ is five times as much as that of any antient planet. It is even difficult to conjecture what may be the powers and what may be the dimensions of the products which admit of being neglected; so that the calculations may be so long, and the formulas so compli-

cated

cated as to discourage geometers and astronomers the best qualified to execute a work of this kind.

Two years ago the Class of Physical and Mathematical Sciences of the Institute determined, from this consideration, to propose the subject for the prize to be distributed at the public sitting on the first Monday in Messidor of the year XIV. But the term having appeared too short, and the number of the planets being again increased by the discovery of Juno by M. Harding, of which the eccentricity appears to be still greater than that of Pallas, and the inclination of 13 degrees greatly exceeds that of all the other planets except Pallas; the Class has thought proper to propose the same subject again, with some modifications and a double prize. They accordingly invite astronomers and geometers to discuss completely all the points of this theory, with the omission of none of the inequalities which may become sensible; and as these inequalities cannot be well determined if the elliptical elements be not perfectly known, it is indispensible that the concurrents should not confine themselves to give the numerical coefficients of the equations. It is more particularly important to exhibit analytical formulas, in order that substitution may be successively made of more exact values of the mean distance, the eccentricity, the perihelium, and the inclination, accordingly as the elements shall become better known. The concurrents may even dispense with giving any numerical value, provided the analytical expressions be presented sufficiently in detail to enable an intelligent calculator to follow the developement and reduce them into tables.

Another advantage will result from these general formulas; namely, that the planets Ceres, Pallas, and Juno being at distances from the sun so little different that it can scarcely at present be with certainty decided which of the three is the nearest or the most remote: the formula given for Pallas may serve equally for the two others, as well as for every planet which may hereafter be discovered which shall have its eccentricity and inclination within the same limits.

The Class entertains the hope that this question will appear of sufficient interest to geometers to induce them

to make exertions proportioned to the difficulty of the subject. The prize which will be proclaimed in the public sitting of the first Monday in January 1809 will be a gold medal of 6000 francs (£250).

The works presented must be written either in French or in Latin, and will not be received later than October 1, 1808. This term will be strictly attended to. The other conditions are as usual.

Nitrate of Soda.

Nitrate of soda burns three times as long as common nitre, &c.

Professor Proust writes to Dr. Delamethere, that he finds the nitrate of soda an economical article for fire works. Five parts of the nitrate, one of charcoal and one of sulphur, afford a powder which gives a flame of a reddish yellow, of considerable beauty : and the mixture burned in a metallic tube, will last exactly three times as long as the same charge of common powder.

The nitric acid in this combination is not decomposed to the same degree as that of nitrate of potash. Its gases are a mixture of carbonic acid, with a small quantity of gaseous oxide of azote, and much nitrous gas.

The cheapest method of obtaining nitrate of soda, would no doubt be to use soda, instead of potash, to saturate the mother waters.

Examination of the Birds' Nests which are eaten in China, and other Eastern parts.

Birds' nests of the East.

The same chemist has examined the birds' nests of the East and finds them to consist merely of a single piece of cartilage, uniform in its texture. He boiled one in water, which became soft, but was not separated in its parts and what was still more remarkable, it lost only four hundredths of its weight.

Subterraneous Road or Tunnel, made upwards of three Centuries ago (Journal des Mines, Fev. 1806).

Subterraneous passage or tunnel in Italy, made in the fifteenth century.

The Marquis (de Saluces) Louis II. being desirous of increasing the commerce of the country dependant on his sovereignty, undertook in the fifteenth century to make an excellent road in the valley of the Po, which

passing

passing over a mountain, placed beside Mount Viso, called La Traversetta, should lead into Dauphiny.

But as this passage was surrounded by frightful precipices and was only passable for men on foot, he dug through the body of the mountain, a passage, which, without the assistance of gunpowder, was completed in less than five years. This passage is 74 metres (about 80 yards) in length, four in width, and about the same in height.

The opening through this mountain has been attributed by some to the ancient Romans, at the time when they penetrated into Gaul; others have ascribed it to the celebrated warrior of Carthage, who made the Romans tremble, and was their eternal enemy. But it is certain that it was effected by the Marquis Louis II. The acts relating to several undertakings, composing part of this work, still exist in the archives of the former office of Secretariat of the interior of Piedmont, and Mr. Bresli, sub-prefect of the Arrondissement, author of Notices Historiques de la Ville de Saluces, published at Turenne in the year XIII. asserts that he himself being occupied on the spot in clearing this passage from rocks and other obstacles which had detached themselves from the mountain, observed on the right hand within the same passage, the engraved date of 1480, the epocha at which this work was finished.

Method of conveying Carp and Pike to great Distances alive.

This method which is no less simple than easy, and which I am informed is also practised in England, is mentioned in La Revue. It may be practised by any proprietor of ponds, and may afford a good return if used in situations where carriage may easily be had. The fish it is said, may be thus conveyed some hundreds of miles, in a state of life and health equal to what they possessed when first caught. Carp and Pike.

Crumb of bread is soaked in brandy, and when well swelled, it is used to fill the whole of the fish's mouth, into which, half a glass more of the spirit is then to be poured. The fish remains motionless and as if deprived of life;

life; in which state it is to be wrapped in fresh straw, and afterwards in a cloth.

In this condition the fish may be kept or conveyed to any distance for eight or ten days. When arrived at the place of destination, they must be unpacked and thrown into a cistern of water, where they remain a quarter of an hour, or sometimes and hour, without shewing any signs of life; but at the end of that time they disgorge very abundantly and recover their life and ordinary motions.

Horse-Chesnuts as Food for Sheep.

Horse Chesnuts for Sheep.

The fruit of the horse-chesnut tree is collected in Saxony for feeding sheep, where it is considered as an wholesome food and a specific remedy against the rot. It is given to them in Autumn when the green food is no longer to be had. The horse chesnuts are cut in pieces and distributed in the quantity of about two pounds and a half for each, and less for the lambs. Sheep as well as cattle at first refuse it, but greedily take it when custom has made it familiar. They eat the prickly outside with satisfaction. There is danger in giving these fruits without cutting them in pieces, as they may stick in the throat and occasion the death of the animal.

Mr. CUTHBERTSON, No. 54, Poland Street, Philosophical Instrument Maker, and Member of the Philosophical Societies of Holland and Utrecht, has in the Press his Work on Practical Electricity and Galvanism; being a Translation of the most interesting Experiments contained in a Treatise published by him during his residence in Holland, with the addition of all such as have since been invented by Himself and Others; together with an Appendix, containing the most interesting Experiments on Galvanism.